POINT THOMSON
GAS CYCLING PROJECT

ENVIRONMENTAL REPORT: EXPORT PIPELINE

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1.0 Project Overview

ExxonMobil proposes to develop the Thomson Sand reservoir in the Point Thomson Unit located east of Prudhoe Bay, Alaska. The Point Thomson Unit is composed of multiple State leases with different ownerships. ExxonMobil is the Unit Operator and has a working interest in the Unit of approximately 36 percent (%). Other major working interest owners include: BP Exploration Alaska, Inc. (~31%), ChevronTexaco (~25%) and ConocoPhillips (~5%). Other minor interests comprise the remaining 3%.

1.1 Purpose and Need

1.1.1 Purpose of the Project

The purpose of the proposed project is to produce gas condensate from the Point Thomson Unit and deliver that condensate to the Trans Alaska Pipeline System at Prudhoe Bay for shipment to market. This Project Description provides a summary of the current development concept for the preferred alternative, which has been selected based on engineering, economic, and environmental evaluations conducted during Conceptual Engineering.

1.1.2 Need for the Project

Development of this resource will help the United States meet domestic energy demand. Initial average annual production of condensate is expected to be approximately 75,000 barrels (bbl) per day. It is estimated this project could sustain economic production for 30 years or longer. Through taxation and creation of jobs, the Point Thomson Gas Cycling Project will also provide economic benefits to the State and local communities including the North Slope Borough (NSB). This will include both temporary jobs during drilling and construction, and long-term jobs supporting permanent operations. Over the life of the project, significant benefits will accrue to the State and NSB through the payment of royalties, severance, income, and *ad valorem* taxes.

1.2 PROJECT SAFETY, HEALTH, AND ENVIRONMENTAL (SHE) OBJECTIVES AND STRATEGIES

ExxonMobil's primary objective is to deliver exemplary Safety, Health, and Environmental (SHE) performance by providing a workplace free from accident and illness. Goals of this objective are no lost-time incidents, and overall safety, health, and environmental performance that equals or exceeds the best of international operators.

Strategies to ensure flawless achievement of this objective include:

- Employing contractors experienced in the Alaskan North Slope environment, and keeping scope and execution approach within their proven capabilities;
- Learning from experience of prior projects, particularly those on the North Slope;
- Leveraging project management resources via an Engineering Procurement Construction Management contractor;
- Using proven ExxonMobil project management systems and practices;
- Engaging co-venturers via ongoing consultation and formal reviews;
- Including experienced personnel from co-venturers in the project team;
- Focusing on interface management and emphasizing ExxonMobil's high business ethical standards; and
- Implementing sound, verifiable business controls.

There are a number of design and operational features of the project that are planned to reduce environmental impacts and capital costs of the development (including the remoteness of Point Thomson from existing infrastructure):

- Shore-based extended reach drilling (ERD) from a minimum number of well pads;
- Use of the existing Badami and Endicott sales oil pipelines to transport condensate to the Trans Alaska Pipeline System (TAPS);
- No permanent roads to Badami or Prudhoe Bay infrastructure;
- Use of existing exploration pads and gravel where technically and economically feasible;
- Zero discharge policy for drilling wastes;
- Class I (Industrial) injection well for underground disposal of most waste streams including drilling waste, produced water, and camp discharges;
- Use of existing and new gravel mines at Point Thomson for freshwater sources; and
- Timing and/or routing of marine support operations to minimize potential disturbance to subsistence hunters and whaling crews.

1.3 Project Summary

The Point Thomson Unit is located on the North Slope of Alaska immediately west of the Staines River, approximately 22 miles (mi) (35 kilometer [km]) east of the Badami Development (Figure 1-1). Thomson Sand is a high-pressure gas reservoir that was discovered in 1977. The reservoir is estimated to contain more than 8 trillion cubic feet of gas and over 400 million stock tank bbl of recoverable condensate.

The Point Thomson Unit owners are proposing to develop this reservoir with a “gas cycling” project. A gathering pipeline system will collect production from well pads located on the eastern and western margins of the reservoir and deliver the three-phase stream to the Central Processing Facility (CPF). Gas, water, and hydrocarbon liquids (condensate) will be separated from the three-phase stream at the CPF. Dry gas[1] will re-injected into the reservoir at the Central Well Pad (CWP) located near the CPF. A small amount of the gas will be used to supply fuel for the facility. Produced water will be re-injected into one or more disposal wells at the CWP.

Condensate is the hydrocarbon liquid that condenses from the production stream as the high pressure and high temperature of the reservoir are reduced in the surface gathering and processing facilities. The separated condensate will be dehydrated and stabilized at the CPF to meet pipeline specifications.

Also located at the CPF will be infrastructure designed to support remote operations including temporary and permanent camps; office, warehouse and shop space; normal and emergency power-generating equipment; fuel, water, and chemical storage; and treatment systems for potable and effluent water. An airstrip will be built south of the CPF, and a dock will be constructed adjacent to the CWP. Because no permanent roads between Point Thomson and Prudhoe Bay or other North Slope infrastructure are proposed, the dock and airport facilities are critical to supporting long-term operations.

The recovered hydrocarbon condensate will be shipped to market through a new 22-mile (35-km) export pipeline that will extend from Point Thomson to the Badami Development, where it will tie

[1] The term “dry gas” refers to the gas leaving the process facilities and injected into the reservoir. This gas is stripped of condensate and produced water prior to injection.

into the existing Badami and Endicott sales pipelines, with ultimate delivery to TAPS Pump Station No. 1.

Subsequent sections of this document describe the affected environment, environmental consequences, and mitigation measures associated only with construction and operation of the export pipeline of the Point Thomson project.

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2.0 PROJECT DESCRIPTION-EXPORT PIPELINE

2.1 RESERVOIR

The Point Thomson Field is a major hydrocarbon accumulation that was discovered in 1975. The primary reservoir, the Thomson Sand, was discovered in 1977 and is a large, over-pressured gas-condensate reservoir located approximately 12,750 feet (ft) (3,886 meters [m]) below sea level. A total of 19 exploration wells have been drilled in and around the field, and numerous seismic surveys have been acquired to further delineate this extensive (approximately 23 mi by 8 mi [37 km by 13 km]) resource. The western edge of the field is about 45 mi (72 km) east of Prudhoe Bay, and the nearest surface facility is the Badami Development, located about 22 mi (35 km) west of the Point Thomson CPF (see Figure 1-1).

The Point Thomson Unit was formed in 1977 and the State designated ExxonMobil (formerly Exxon Company U.S.A.) as the Unit Operator. Throughout the 1980s and 1990s, ExxonMobil and other Point Thomson Unit owners continued to delineate the Thomson Sand and shallower Brookian accumulations within the Unit while conducting development feasibility studies. In April 2000, interests among the major Point Thomson Unit owners were realigned for all horizons. Currently, the Point Thomson Unit covers approximately 117,000 acres (47,348 hectares [ha]).

2.2 EXPORT PIPELINE SYSTEM

The Point Thomson Export Pipeline will be designed, built, and operated as a common carrier system according to proven North Slope design criteria. The export system will consist of a 12.75-in (32 cm) carbon steel pipeline approximately 22 mi (35 km) long to transport condensate from the CPF to a connection point with the existing Badami pipeline. The pipeline will have a maximum allowable operating pressure (MAOP) of approximately 2,060 psi gauge (psig) [14,200 kPa]. Pig launchers and receivers will be included on this pipeline. From the tie-in point, the existing 12-in. (30.5-centimeter [cm]) Badami pipeline extends another 25 mi (40 km) to tie in with the Endicott pipeline, which extends another 10 mi (16 km) before connecting to TAPS Pump Station No. 1 at Prudhoe Bay.

The proposed Point Thomson Export Pipeline will be supported on VSMs complete with “Z” type offsets and/or expansion loops to allow for thermal effects. The VSMs will be designed and installed to provide minimum separation of 5 ft (1.5 m) between the bottom of pipe and the tundra surface. Design and installation of the VSMs will be completed using standard ExxonMobil and North Slope pipeline specifications and procedures. The VSM design will be performed during the pipeline detailed design. Table 2-1 provides the engineering data as developed to date for the export pipeline.

2.2.1 Route Selection and Route

ExxonMobil’s route selection process for this project incorporated the following design philosophy:

- Minimize pipeline encroachment into high-value vegetation areas.
- Minimize pipeline encroachment over small ponds and standing water.
- Minimize pipeline stream crossing by selecting those portions of the stream that are relatively narrow.

- Minimize pipeline bends.
- Share the same VSMs as the gathering pipeline between the CPF and the West Well Pad.

The route of the proposed pipeline extends about 22 mi (35 km) from the proposed CPF, located approximately 60 mi (100 km) east of Prudhoe Bay, to a point of connection with the existing Badami sales oil pipeline at the Badami Central Processing Unit (CPU). The route, as shown in Figure 2-2, starts at the CPF Pad in Section 3, T9N, R23E, and Section 34, T10N, R23E and ends at the point of connection with the existing Badami sales oil pipeline in Section 8, T9N, R20E.

TABLE 2-1
ENGINEERING DATA SUMMARY FOR THE POINT THOMSON EXPORT PIPELINE

CATEGORY	DATA
Transported Substance	Liquid hydrocarbon (condensate)
Substance Specific Gravity (@ standard conditions)	0.7 to 0.9 (water = 1.0)
Maximum Allowable Operating Pressure (MAOP)	2,060 psig (14,200 kPa)
Pipeline Outside Diameter	12.750 inches
Pipeline Wall Thickness:	**Mainline:** 0.281 inch **Station piping & valve and trap sites:** 0.375 inch
Pipe Material Grade	API 5L X65
Design Hoop Stress Factor	**Mainline:** 0.72 **Station piping & valve and trap sites:** 0.60
External Coating	**Mainline:** Polyurethane foam (PUF) insulation with galvanized metal outer jacket **Buried Road Crossings:** Fusion bonded epoxy and PUF insulation with galvanized metal outer jacket
Cathodic Protection	None
Minimum Hydrostatic Test Pressure & Duration	4 hr at minimum pressure of 125% MAOP and 4 hr at minimum pressure of 110% MAOP in accordance with U.S. Department of Transportation regulations (49 CFR, Part 195).
In-line Inspection Capability	Yes
Valves (To be determined**)**	**Mainline:** Automated isolation valves at the inlet and outlet of the pipeline **Check:** None
Other Facilities	
Badami Meter	Meter at Badami CPU on or adjacent to existing pad
Badami Line Heater	Heater at Badami CPU on or adjacent to existing pad
Pigging Facilities	Pig launcher facility at Point Thomson CPF and pig receiver at Badami CPU on or adjacent to existing pad.
Pumps	Pumps at the Point Thomson CPF
Point Thomson Meter	Meter at the Point Thomson CPF
Pipeline Design Maximum Throughput	100,000 bbl/day
Pipeline Design Temperatures	**Maximum:** 150°F (66°C) **Minimum:** -50°F (-46°C)
Pipeline Construction Mode(s)	**Mainline:** VSMs, minimum 5-ft (1.5-m) clearance between bottom of pipe and tundra surface **Road Crossings:** In culverts or casings through road bed gravel placed on the tundra (see Figure 2-1) **Creek and Water Crossings:** VSMs
Design Code/Regulation	49 CFR, Part 195
Minimum Operational Life	30 years

The entire length of the pipeline right-of-way (ROW) will cross lands owned by the State of Alaska. Figure 2-1 shows the approximate centerline alignment of the proposed route. The width and depth of stream or water body crossings will be determined and provided after field survey; however, all stream and water body crossings from Point Thomson CPF to the Badami tie-in will be constructed above-grade using VSMs. No below-grade river or stream crossings are planned, nor are they necessary because the streams traversed by the pipeline are small.

2.2.2 Pipeline Material

As shown on Table 2-1, API 5L X65 pipe material will be used for the pipeline.

2.2.3 Pipeline Capacity

As shown on Table 2-1, the pipeline is presently designed for a maximum throughput of 100,000 bbl/day.

2.2.4 Pipeline Integrity Monitoring System

The proposed pipeline design will include a computational leak detection system in accordance with federal and state requirements. The system will perform real-time monitoring for pipeline leakage and will likely rely on operating data such as liquid hydrocarbon flow and pressure meter data. Meters will be provided on each end of the export pipeline (i.e., one at the CPF and one at the tie-in to the Badami pipeline). This information will be used to compute mass-balance calculations that will be able to detect a leak volume of at least 1% of the daily throughput. The operating data will be continually updated, gathered from field instruments, and compiled in the host computer via the supervisory control and data acquisition (SCADA) system. Specific hardware and software options for the leak detection system will be evaluated and selected later in project design.

Mainline valves will be installed at the pipeline inlet and outlet in accordance with the requirements of 49 Code of Federal Regulations (CFR), Part 195. In-line mainline valves or vertical loops, which will be evaluated and defined during preliminary design, may be installed to limit the amount of the condensate that can be spilled in the event of a pipeline leak or rupture. Shutdown procedures will be developed to meet regulatory and industry standards.

Pig launchers and receivers will be installed, and pipeline operations will include periodic in-line inspections using intelligent pigging tools to collect baseline and subsequent data sets for monitoring the condition of the pipeline over its operating life.

As discussed in Section 12, the Point Thomson Oil Discharge Prevention and Contingency Plan (ODPCP) will be developed and implemented in accordance with Alaska Department of Environmental Conservation regulations (18 AAC 75), which include plans for prevention of and response to any spills of oil, fuel or other substances. The ODPCP will provide specific spill containment and prevention measures, equipment needs, and response strategies. This ODPCP will address oil spill prevention and response to protect public health and safety during pipeline operation. Measures to protect public health and safety during pipeline operation include an ongoing inspection and maintenance program.

2.2.5 Corrosion Management

An internal protective coating is not necessary for the pipeline because condensate transported in the line will have low water and sulfur contents and thus would not cause corrosion of the inside wall of the pipelines. The addition of corrosion inhibitors to the fluid streams may be considered if required by the ultimate fluid properties and operating conditions. Cathodic protection for external corrosion control was not considered because above-ground pipelines do not require it.

2.3 CONSTRUCTION PLAN

2.3.1 First-Year Construction Scope

The objective of the first construction year is to have all required drilling support infrastructure in place by October 2005, the proposed start of development drilling. The scope of work for 2005 regarding the export pipeline may include the construction of potential valve pads (see Section 2.2.2.4 below). The majority of civil construction is expected to be complete by April 2005, with the exception of final gravel compaction and shaping activities during June to July 2005.

2.3.1.1 Ice Roads

Depending on weather conditions, construction of a grounded-sea-ice road connecting Endicott to Point Thomson could begin late November 2004 and is expected to be completed by late December 2004 or early January 2005. The road will be designed, constructed, and maintained to support the first-year construction effort, including transport of heavy equipment, materials, construction camps, and personnel to the site.

2.3.2 Second-Year Construction Scope

The objective of the second construction year is to install and commission all pipelines, the CPF modules, flare area, well pad facilities, and remaining telecommunications and controls equipment to support first production in the fourth quarter of 2006. Most pipeline construction will be conducted during the winter using both sea and inland ice roads to minimize impact to the tundra. All pipelines will be installed above ground using VSMs.

2.3.2.1 Ice Roads

Construction of the sea ice road for the second year of construction will be similar to that of the first year. Work will begin in November 2005, weather permitting, with completion in early January 2006. Construction of the inland ice roads for the export condensate pipeline is expected to begin mid-January 2006 based on the anticipated opening date for tundra travel, and should be complete by mid-February 2006.

2.3.2.2 Pipeline

Pipeline construction is planned to begin mid-January 2006. The export pipeline will be built mostly during the winter using proven conventional arctic onshore equipment and techniques. The pipeline will be pre-insulated offsite and trucked to the site on ice roads. All other pipeline materials (VSMs, pipe racks, pipe spools, pig launch and receiver skids, etc.) will be prefabricated and trucked to Point Thomson on ice roads beginning January 2006.

2.3.2.3 VSM and Pipeline Installation

The pipe laying process will commence in January with surveyors staking the VSM installation positions. VSM holes will be drilled and the tailings cleared. Then VSMs will be strung along the pipeline alignment together with the beams. The VSM assemblies will be set in the holes, which are typically filled with sand/water slurry.

Pipeline road crossings will be installed through casing/culvert that is buried in the road bed gravel, which will be placed on top of the tundra. Figure 2-2 llustrates a typical road crossing.

Upon completion of VSM installation on a segment of the pipeline, joints of pipe will be transported to the site, strung along the pipeline alignment, and welded together to form a continuous string. Each weld produced in the field will be examined by non-destructive testing

(NDT). The pipeline strings will then be lifted onto the VSMs, with tie-in welds performed and tested by NDT. Applying insulation to the tie-in welds will conclude the pipe laying activities.

Storage and laydown areas may be required in support of pipeline construction. These areas would be ice pads, snow pads, space on existing gravel pads, or space on new gravel pads to be constructed in the Point Thomson Unit. Information will be provided at a later date regarding the exact location(s) of these storage areas.

2.3.2.4 Valves and Valve Pads

Additional areas may be required for possible valve installation along the export pipeline, if valves are found to be required during the detailed design phase. Location and sizes will be determined as engineering design matures. Any gravel pads needed to support valves will be approximately 5 ft (1.5 m) thick and sides will be sloped nominally at 2:1.

2.3.2.5 Badami Tie-In

The connection to the Badami pipeline will include valve facilities similar to those typically used in North Slope production and may include a heater.

2.3.2.6 Pig Launching Facilities

Pig launching and receiving facilities will be provided for the export pipeline. There will be a pig launcher at the Point Thomson CPF and a pig receiver at the Badami CPU or on an adjacent pad. Section 2.2.4 above, describes pipeline monitoring and the use of pigs.

2.3.2.7 Hydrotesting

The export pipeline will be hydrostatically pressure-tested in accordance with accepted industry codes and regulations. The procedures for hydrostatic testing and caliper pigging of the pipeline have not been established to date. If not completed during the winter construction period, these activities may be performed during the summer and fall before the start of production. Three scenarios are being considered:

- Drawing fresh water from local water sources, and filtering and discharging the water to tundra after hydrotest (as authorized under the applicable National Pollutant Discharge Elimination System [NPDES] permit).
- Using seawater, and filtering and discharging the water back to the ocean after hydrotest (as authorized under the applicable NPDES permit).
- Using a glycol/water mixture, and disposing of the mixture after use in the Point Thomson disposal well or sending it to Prudhoe or other suitable facility for recycling.

2.4 OPERATIONS AND MAINTENANCE

2.4.1 Introduction

Operations and maintenance of the Point Thomson export pipeline will be governed by the operational requirements for the project. These specifications will incorporate a central control room (CCR) for functional control of monitoring security, safety surveillance of emergency shutdown systems, a fire and gas monitoring system, remote activation of pig launching operations, and data gathering as may be required by a surveillance system. In addition, Production Operations Best Practices (POBP) will be used for any issues/concerns not covered by the specifications.

The following section provides descriptions of the operational requirements, including maintenance issues, for the pipeline.

2.4.1.1 Export Pipeline Maintenance

The export pipeline will not require major effort to ensure trouble-free function. Visual external inspection of the export pipeline will occur from existing roads, or by air where road access is not possible. Internally the pipeline will be periodically inspected using “smart” pigs. The facilities containing the isolation valves, pig launchers/receivers, and associated instrumentation and controls may be contained in enclosures.

Repairs to the pipelines and facilities can be completed from roads running along the alignment of the pipelines (where roads are available), by using Rolligons when tundra travel is allowed, or from ice roads built during winter to access a specific location. Access can also be achieved by employing a helicopter to move personnel and equipment directly to a specific location for minor repair and maintenance. Typically, minor repairs will require only hand tools and, possibly, welding equipment. Major repairs might require the use of earth-moving equipment, cranes and lifting equipment, and specialized tools and materials. Minor and major pipeline repairs will be scheduled, where possible, to ensure equipment, materials, and personnel required to conduct these repairs will be available.

In order to provide quick response to minor emergencies and to perform repairs to the facilities dedicated to the pipeline flow and leak detection, spare parts and replacement materials will be maintained at the Point Thomson warehouse.

2.5 SPILL PREVENTION AND RESPONSE

The ODPCP will be developed to cover all site operations and spill response considerations, and will include four major sections:

- *Response Action Plan:* Describes deployment and response strategies for a remote facility and pipeline system, including, but not limited to, information on safety, emergency action checklists, and flow diagrams and incident reporting requirements.
- *Prevention Plan:* Describes regular pollution prevention measures or programs to prevent spills (for example, discussions of tank and pipeline leak detection systems and discharge detection and alarm systems). This section also covers personnel training, site inspections schedules, and maintenance protocols.
- *Supplemental Information:* Describes the facility itself and the environment in the immediate vicinity of the facility. This section also includes information on response logistical support and equipment (mechanical and non-mechanical) and spill response team training.
- *Best Available Technology:* Presents analyses of various technology used and/or available for use at the site for well source control, pipeline source control and leak detection, tank source control, leak detection, liquid level determination and overfill protection, corrosion control and surveys, and mechanical response equipment.

To achieve the spill response capabilities described in the contingency plan, a range of specialized equipment dedicated to oil spill responses will be staged at Badami and Point Thomson. ExxonMobil and Alaska Clean Seas (ACS) will jointly develop pre-staged equipment at the central pads (CFP and CWP), West Well Pad, and East Well Pad. In addition, ACS response vessels will use the Point Thomson and Badami docks for quick mobilization to potential marine and stream spills.

ACS will serve as Point Thomson's Oil Spill Removal Organization and primary Response Action Contractor, approved by the Alaska Department of Environmental Conservation and the U.S. Coast Guard. As they do for the other North Slope oil production operations, ACS technicians will help assemble, store, maintain, and operate Point Thomson's spill response equipment.

The central pads will store most of the facility's oil spill response equipment, which is expected to include a number of containers holding a variety of boom types, oil skimmers, portable tanks, pumps, hoses, generators, and wildlife protection equipment. Snowmachines and other vehicles for off-road access are expected to be stored on the central pads as well. The CPF will be designed to include facilities to support the emergency response teams at Point Thomson. Thus, the central pads will provide the indoor and outdoor facilities to support emergency responses to oil spills throughout the Point Thomson facilities.

To respond to spills into streams and into the marine environment, spill response vessels will be maintained at Point Thomson during open-water seasons. A landing craft, work skiffs, and airboats capable of traversing the shallow waters common in the area are likely to be staged at Point Thomson. Additional response vessels, for example "Island Class" or "Bay Class" workboats, designed to pull long lengths of oil spill containment boom and operate skimmers are also planned. One or more small barges for storing and hauling oil recovered from marine oil spills also will be staged with the vessels. For the most part, the vessels and barges would be stored on trailers and then launched from the dock.

3.0 AFFECTED ENVIRONMENT

3.1 METEOROLOGY

The climate of the Point Thomson area is Arctic Marine, characterized by extremely low winter temperatures and short, cool summers. Winds are persistent throughout the year, with blizzards occurring frequently during the winter. The sun remains below the horizon in the area from late November through mid-January.

Meteorological data for the area are limited; there are historical data collected at Barter Island, located about 60 miles (mi) (97 kilometers [km]) to the east. These data include daily measurements of temperature, wind speed and direction (velocity), precipitation, and other parameters for 1949 through 1988. The Alaska North Slope Eastern Region (ANSER) monitoring station at Badami, about 15 mi (24 km) west of the project area, has collected background climatic data including temperature and wind velocity since first quarter 1999, as well as precipitation since fourth quarter 1999. Temporary stations located at Flaxman Island (summer 1997 and 1998) and on the mainland south of Flaxman Island (summer 1999) recorded temperature and wind velocity.

3.1.1 Temperature

From year to year, the average monthly temperature, especially in winter, can vary widely. For example, at Barter Island, the average January temperature was 4.5 degrees Fahrenheit (°F) (-16.5 degrees Celsius [°C]) in 1981 and -21.8°F (-6°C) in 1983. The recorded minimum temperature at Barter Island was -59°F (-51°C) in February 1950 and the maximum was 78°F (26°C) in July of 1978 (USFWS 1987). In summer, variations are less pronounced, but more important because the accumulation of days above freezing (thaw index) greatly influences the depth of thaw in the soil and the rate of melting of ice on the water bodies. Table 3-1 compares temperatures recorded at Barter Island and Badami. The table shows that the mean temperature ranges and mean annual temperatures are comparable between the locations.

Table 3-1 Mean Annual and Mean Temperature Ranges Near Point Thomson

LOCATION	MEAN ANNUAL TEMPERATURE °C	MEAN TEMPERATURE RANGE °C	PERIOD OF MEASUREMENT
Barter Island	-12.3	-45.4 to 26.3	1949-1988
Badami	-12.7	-42.2 to 22.3	1999-2000[1]

[1]July to June
Sources: USFWS 1987, ANSER 2000

3.1.2 Precipitation

Precipitation in the Point Thomson area is light, but frequent, occurring as drizzle in summer and as light snow in the winter months. Although rain accounts for most of the annual precipitation along the coast, snow begins falling in September and usually remains on the ground from October through June (BLM 1979). Table 3-2 summarizes the precipitation data for the Barter Island and Badami stations.

Table 3-2 Precipitation Data Summary Barter Island And Badami

LOCATION	MINIMUM MONTHLY PRECIPITATION (INCHES [IN.])	MAXIMUM MONTHLY PRECIPITATION (IN.)	AVERAGE ANNUAL PRECIPITATION (IN.)	PERIOD OF MEASUREMENT
Barter Island	0.19 (April)	1.1 (Aug.)	6.19	1949-1988
Badami	0.28 (March)	1.5 (Dec.)[2]	NA	1999-2000[1]

[1]October to June
[2]No measurement taken in summer
Sources: USFWS 1987, ANSER 2000
NA – not available

The Barter Island data exhibits an average summer precipitation of 0.52 inch (in) (1.32 centimeters [cm]) in June, 1.01 in (2.57 cm) in July and 1.1 in (2.8 cm) in August. Rainfall rarely exceeds 0.5 in (1.27 cm) in any one day. A 10.8 in (27.4 cm) average annual snow depth recorded at Barter Island (USACE 1984) is representative of the area.

On the North Slope, relative humidity is generally high during the summer, reaching 80 to 95 percent (%) along the coast (LGL et al. 1998). Relative humidity in the winter months drops to about 60 %. On average, foggy conditions occur 76 days per year at Barter Island; ice fog forms when ambient temperatures drop below -20.4°F (-29° C) (USACE 1984).

3.1.3 Winds

Winds on the arctic coast are persistent and tend to parallel the coastline. Easterlies occur about twice as frequently (60%) as westerlies (30%); the remaining time (10%) winds are calm or light and variable. Figure 3-1 provides a wind rose for Barter Island. Prevailing easterly winds consistently average 13.4 miles per hour (mph) (22 kilometers per hour [km/hr]) at Barter Island (usually East North East to North East). From January to April, the prevailing direction is westerly (WCC 1981). The windiest month usually is January (mean 15 mph [24 km/hr]) and the calmest is July (mean 10.7 mph [17 km/hr]). The peak gust (westerly) recorded at Barter Island was 75 mph (121 km/hr) in January 1980 (USFWS 1987). Sea breezes occur during about 25% of the summer and extend to at least 12.5 mi (20 km) offshore (MMS 1996). Persistence of the wind from either direction varies from 1 to 14 days with typical events lasting 2 to 5 days (Colonell and Nioderoda 1990). Winds exceeding 31 mph (50 km/hr) occur about 2 to 8 % of the time.

The Point Thomson area meteorological station data (summers 1997-1999) indicate that locally, east winds are prevalent during the summer and more than 90% of the wind speeds are less than 20 mph (32 km/hr). Maximum observed wind speeds of 31.1 mph (50 km/hr) were recorded during an easterly storm in late August 1999.

3.1.4 Air Quality

The ANSER monitoring station also measured several air quality parameters including concentrations of nitrogen oxide, nitrogen dioxide, sulfur dioxide, ozone, and particulate matter. Table 3-3 provides a summary of these parameters as recorded by this study. All concentrations shown in the table are well below the Alaska and National Ambient Air Quality Standards.

Figure 3-1 Wind Rose for Complete Year (1988) at Barter Island, Alaska

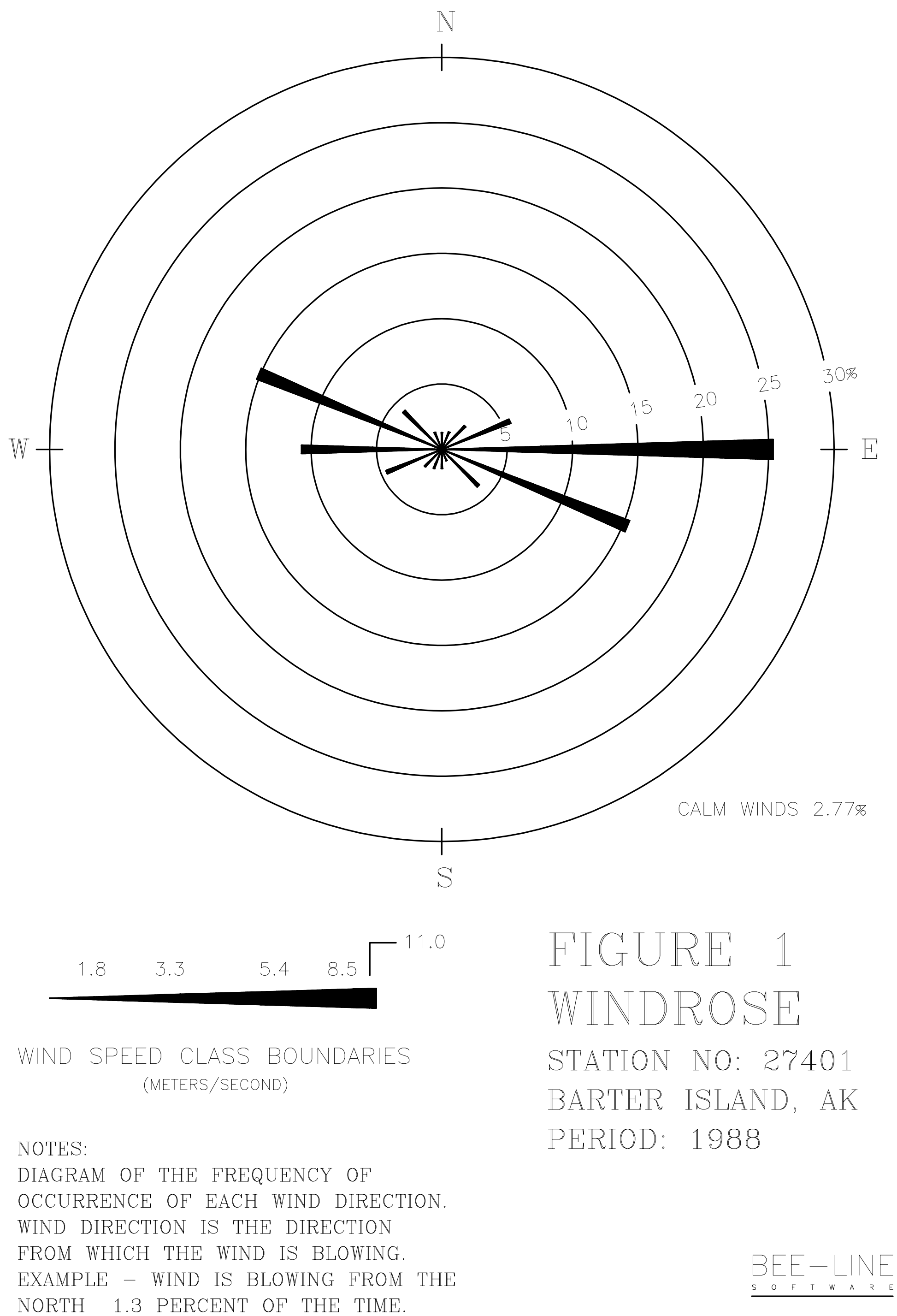

Table 3-3 Air Quality Parameters Measured At Badami July 1999-June 2000

PARAMETER	AVERAGE ANNUAL CONCENTRATION	ANNUAL MEAN 24-HOUR CONCENTRATION	HIGHEST REPORTED 24-HOUR CONCENTRATION
Nitrogen oxide (μg/m^3)	3.6	NA	NA
Nitrogen Dioxide (μg/m^3)	3.3	NA	NA
Sulfur Dioxide (μg/m^3)	3.5	NA	NA
Ozone (μg/m^3)	46.1	NA	NA
Particulate matter (μg/m^3)	NA	2.2	25.7[1]

[1]Recorded during nearby construction activities
NA – Not Available
μg/m^3-micrograms per cubic meter
Source ANSER 2000

3.2 GEOMORPHOLOGY

The proposed Point Thomson Gas Cycling project and associated export pipeline are located in the Arctic Coastal Plain (ACP) physiographic unit (Wahrhaftig 1965). The plain rises gradually from the Arctic Ocean and extends southward to the base of the Arctic foothills along the northern edge of the Brooks Range. The coastal plain consists of perennially frozen marine, fluvial, aeolian, and lacustrine sediments underlain by Cretaceous and early Tertiary sedimentary rocks. This is a poorly drained, treeless, periglacial environment with a thick permafrost layer.

The proposed Point Thomson Gas Cycling Project infrastructure is located on the ancient Canning River alluvial fan. This fan can be divided into a coastal zone and an inland zone (LGL et al. 1998). The export pipeline will be constructed in the coastal zone which has been modified by coastal processes throughout a period when sea levels were higher than present. The division between the coastal zone and the inland zone is located approximately 2 to 3 mi (3 to 5 km) south of the coastline at an approximate elevation of 25 to 30 feet (ft) (7 to 9 meters [m]). Wind-oriented lakes dominate the landscape in the Canning River coastal zone and in the area west of the ancient Canning River alluvial fan, which starts at the southern limit to Mikkelsen Bay. Thaw lake basins originate in areas of restricted drainage where shallow ponds form during the warmer summer surface temperatures. The warmer temperatures cause the underlying ground ice to thaw resulting in subsidence. Most of these ponds and lakes are less than 4 ft (1.2 m) deep (BPXA 1995).

3.2.1 **Permafrost**

Permafrost is defined as the thermal condition of soil or rock in which temperatures below 32 °F (0°C) persist over at least two consecutive winters and the intervening summer; moisture in the form of water and ground ice may or may not be present. Earth materials in this condition may be described as perennially frozen, irrespective of their water and ice content.

Although mean annual air temperature is basic in determining permafrost distribution, the mean annual ground temperature is the key that determines presence or absence of permafrost. Ground temperatures depend on the climatic history of an area, thermal properties of the earth materials, depth below the ground surface, season, moisture content of surficial soils, vegetative cover, solar gain during the summer, and thickness of insulating snow layers in the winter. In the project area, typical ground temperatures at a depth of 25 ft (7.6 m) range from 10°F to 20°F (-12 °C to -6.1 °C) (LGL et al. 1998).

Even in the coldest parts of Alaska, there exists a thin layer of soil known as the active layer. This layer thaws every summer and insulates the permafrost from the ground surface. The thickness of the active layer on the North Slope varies in thickness locally from 0.5 to 5 ft (15 cm to 1.5 m) or more adjacent to significant streams, and can change when the surface is disturbed. The thickness of the active layer in the project area ranges from less than 1 ft to 5 ft (30 cm to 1.5 m) and averages about 2 ft (60 cm) (LGL et al. 1998).

The amount of ice present in the surficial permafrost deposits can vary from none to nearly 100% by volume. The proportion of ice to mineral or organic material depends initially on the water present in the material before freezing, but during the freezing process (and during annual temperature cycles) the ice and soil may become segregated. The segregated ice may take the form of irregular masses or lenses. Ice lenses range in thickness from less than 1 in (2.54 cm) to several ft, commonly forming vertically oriented wedges that thin downward and may be tens of ft deep and several ft wide at the top (LGL et al. 1998).

The amount of ice present and the soil type determines the thaw settlement behavior of a soil. Coarsely grained soils (sand and gravel) generally contain less ice by volume and experience less thaw settlement than silty-sands and silt that may typically contain considerable amounts of ice. During a recent geotechnical exploration program of the Point Thomson area, however, areas were encountered where considerable ice was found in coarsely grained soils (DM&A 1997).

3.3 HYDROLOGY

The Staines and Canning Rivers border the eastern portion of the project area and the Shaviovik River is located about 5 mi (8 km) west of the proposed Badami tie-in location. The headwaters of the Canning River are in the Brooks Range, approximately 110 mi (177 km) south of the coast. The Staines River forms an alluvial delta just east of the proposed project area. The Shaviovik River, from its headwaters in Juniper Creek to the coast, is about 100 mi (160 km) long. Most of the flow from the Shaviovik River appears to discharge into Foggy Island Bay, west of the Point Thomson project area. Several minor tundra streams are located within the proposed pipeline right-of-way (ROW) corridor. These tundra streams are generally small, meandering, and drain into larger streams or Lion Bay. For the most part, the tundra streams are confined to a single channel, although larger streams may have braided channels. Many tundra streams are beaded, meaning that they consist of a series of small ponds interconnected by short, narrow stream segments.

As summarized in Section 3.2, wind-oriented lakes dominate the landscape in coastal zone of the Point Thomson area. Soil in the area is generally poorly drained due to the shallow depth to permafrost and the low slope of the terrain. The shallow thaw lakes follow a cyclic pattern of formation and drainage. Thaw lakes originate from low-center polygons and tundra ponds by wind-driven thermokarst erosion during the warm season (Britton 1957; Carson and Hussey 1961; Billings and Peterson 1980). Thaw lakes go through a cycle of development, expansion, drainage, and revegetation until they are incorporated by a stream that provides constant drainage.

3.3.1 Snowmelt Floods

Mean annual precipitation is approximately 5 in (12.7 cm) per year with total snow accumulation estimated to be approximately 10 in (25.4 cm). During the long winter, a substantial portion of the precipitation is lost to sublimation. Due to the transport of snow by drifting, the actual amount available in a particular small drainage basin can vary widely depending on the ability of the local relief to trap snowdrifts.

During snowmelt, the initial runoff occurs as sheet flow over the frozen ground surface where infiltration is practically nonexistent. As breakup continues, the snowmelt runs over the frozen surface of small streams and ponds behind snowdrifts. As breakup progresses, these small drifts thaw or are overtopped, and the accumulated melt water is released to flow downstream until it again ponds behind another snowdrift or flows into an open water stream or river. This storage and release process results in an unsteady and non-uniform flow during breakup. Typically snowmelt floods occur every year.

Once the breakup crest has passed a particular point on a stream, the recession is rapid. Typically, the flow on a small stream two weeks after the breakup crest will be less than 1% of the peak flow, and the intermittent drainages will be dry within two weeks. During breakup, the bed and banks of small drainages tend to remain frozen, thereby limiting erosion.

Floods on small streams have historically occurred solely as a result of snowmelt, which responds to a rapid seasonal increase in temperature. As a result, snowmelt floods on a given stream tend to occur at about the same time each year. In 1998, nearly all of the streams crested on May 29 or 30. At peak stage (water surface elevation) many of the channels were between 10 to 50 % blocked by snow. The peak discharge appears to have occurred at a lower water surface elevation, although typically above bankfull (LGL et al. 1998).

Strudel scour occurs along the coast when snowmelt floods overflow onto sea ice and drain through holes in the ice. Due to limited number of holes in the ice, the velocity of the water flowing through them can be strong enough to scour the seabed. The size and shape of the scour is dependent upon a number of parameters, such as the water depth, overflow depth, and seabed soil type.

3.3. 2 Rainfall Floods

Summer floods are not anticipated to occur on the smaller streams within the project area. Similar small streams in the region have not produced floods because of the relatively small watershed (drainage basin), the low intensity of the rainfall, and the large capacity of tundra and thaw lakes to absorb and retard runoff. However, summer floods resulting from unusually heavy precipitation in the Brooks Range occur on rivers such as the Canning, Staines and Shaviovik Rivers. These floods are not frequent, but may be larger than typical break-up floods (BPXA 1995; LGL et al. 1998).

3.4 VEGETATION AND WETLANDS

In the area of the proposed ROW the physical environment controls most plant growth and establishment. Geomorphic processes are responsible for initiating open habitats for colonization and succession. Shallow thaw-lakes in the coastal zone originate from low-center polygons and tundra ponds by wind-driven thermokarst erosion during the warm season (Britton 1957; Carson and Hussey 1961; Billings and Peterson 1980). Lakes grow and coalesce until they are captured by a stream and drain out. Following drainage the wet basins are colonized, within a few years, by pioneer graminoid plant and moss species (Ovendon 1986). The floristic composition of the basins changes gradually over time while the ice-wedge polygonization in the permafrost of the underlying sediments re-asserts itself near the surface. One result of this reassertion is the appearance of low center polygons, which is followed by erosion of the polygon rims and the beginning of a new cycle. The time dimension of this cyclic change is variable and essentially unknown. It has been estimated at between 1500 and 2500 years (Billings and Peterson 1980). Initial plant invaders and successional sequences vary within and between regions due to localized aspects of the physical environment. For instance, the degree of drainage varies considerably between individual basins and even within a single basin. The project area has been described as lowland loess with wet minerotrophic tundra (Carter 1988; Walker and Everett 1991).

A vegetation survey was conducted in the Point Thomson area in 1998 (Noel and Funk 1999). The boundary of the surveyed area runs along the coast from Point Hobson to the western edge of the Staines River, including Point Thomson and Flaxman Island.The summary included a corridor along the Staines River that extends approximately 7.5 mi (12 km) inland, and the Point Thomson area, where the boundary extends to the southwest up to 3 mi (5 km). A total of 32,990 acres (13,356 hectares [ha]) was mapped. An additional 11-mi (18-km) gap (9091 acres [3681 ha]) between the western edge of the area mapped for Point Thomson and the eastern edge of the Badami map was recently completed. This area specifically covers the potential ROW for the export pipeline The final vegetation map for the Point Thomson project area which also includes part of the Badami area previously mapped (BPXA 1995), encompasses a total of 52,759 acres (21,287 ha). This map is provided as Figure 4-3 of the Point Thomson Environmental Report (ER)[2]

Seventy-seven species of vascular plants and 17 non-vascular plants were identified during collection of ground reference data for the Point Thomson vegetation map. No threatened or endangered plant species are known to occur in the proposed project area. Seven species of rare vascular plants occur on the North Slope and may be found within or near the proposed project area (Murray and Lipkin 1987 and 1997). For example, *Mertensia drummondii* is considered a species of concern (formerly a candidate species) under the Endangered Species Act (ESA) and could be present in localized areas of active dunes near the mouths of streams and rivers. This small (12-16 cm tall) vascular plant has been found in areas of moderately active sand dunes on the Meade River at Atkusuk and the Kogusukruk River near Umiat (Murray and Lipkin 1987). *Potentilla stipularis* occurs in sandy substrates, such as sandy meadows and riverbank silts. *Pleuropogon sabinei* is an aquatic grass that rarely occurs between the *Arctophila* and *Carex* zones in lakes and ponds. *Draba adamsii* has been found near Barrow in eroding turfy polygons near the ocean or streams. *Poa hertzii* is a grass known from sites on the Meade River and within ANWR where it occurs on dry sands in active floodplains. *Erigeron muirii* may occur on some drier soils such as ridges along rivers but it has generally been reported at more inland sites near the foothills. *Aster pygmaeus* is known from sites east of the National Petroleum Reserve-Alaska (NPRA) and is found growing on mudflats and saline soils. However, none of these rare plant species were found during collection of ground reference data for the vegetation map.

The project area is mostly covered by water (35.3 %), including subtidal bays and inlets, rivers, streams, lakes and ponds (Table 3-4 and Figure 4-3 from the ER e). Predominant vegetation types are Moist Sedge, Dwarf Shrub/Wet Sedge tundra complexes (30.3 %) and Moist Sedge, Dwarf Shrub Tundra (22.7 %). Moist Sedge, Dwarf Shrub/Wet Sedge tundra complexes are typically found in high- and low-center polygon areas and in weakly developed strangmoor (reticulated tundra). *Salix* spp., *Dryas integrifolia*, mesic *Carex* spp., and a number of forbs dominate the polygon rims or high centers

[2] URS. 2001. Point Thomson Gas Cycling Project Environmental Report. Prepared for ExxonMobil, Anchorage, AK on behalf of Point Thomson Unit owners, by URS, Anchorage, AK.

Other vegetation types include Wet Sedge Tundra (2.6 %) and Dry Dwarf Shrub Lichen Tundra, including crustose and fruticose lichens (2.1%), with the remaining vegetation types each account for less than 2% of the study area (Table 4-4). Salt marsh areas cover 2.9% of the study area. Human disturbances (gravel pads and associated washouts) cover 0.2 % of the study area and are confined to exploratory pads constructed in the Point Thomson area.

Most of the vegetation types in the study area are considered to be wetlands . Exceptions are the well-drained dwarf shrub, crustose and fruticose lichen communities associated with pingos and some high-center polygons, respectively, and partially vegetated sand dunes. Some riparian areas also are likely to be upland due to their gravel substrate and infrequent inundation. Tundra disturbed by gravel fill also may be converted to upland depending on the thickness of the fill.

Table 3-4 Area and Percent of Area Covered by Vegetation Types in the Point Thomson Study Area, Alaska

VEGETATION TYPE[1]	LEVEL C CODES[1]	TOTAL AREA	
		ACRES	PERCENT
Water (bays, lagoons, inlets, subtidal rivers, tidal rivers, streams, lakes, and ponds)	Ia	18,624.4	35.3
Salt Marsh		1511.6	2.9
Wet Graminoid Tundra (wet saline tundra, saltmarsh)	IIIb	*545.4*	*1.0*
Wet Barren/Wet Graminoid Tundra Complex (barren/saline tundra complex, saltmarsh)	IXh	*286.4*	*0.5*
Dry Barren/Forb, Graminoid Complex (saline coastal barrens)	IXi	*679.8*	*1.3*
Aquatic Graminoid Tundra	IIb	228.3	0.4
Water/Tundra Complex	IId	167.4	0.3
Wet Sedge Tundra	IIIa	1383.4	2.6
Wet Sedge Tundra/Water Complex	IIIc	538.0	1.0
Moist Sedge, Dwarf Shrub Tundra/ Wet Sedge Tundra Complex		15,990.5	30.3
Wet Sedge/Moist Sedge, Dwarf Shrub Tundra Complex (wet patterned ground complex)	IIId	*7010.5*	*13.3*
Wet Graminoid, Dwarf Shrub Tundra/Barren Complex (frost-scar tundra complex)	IIIe	*347.4*	*0.7*
Moist Sedge, Dwarf Shrub/Wet Graminoid Tundra Complex (moist patterned ground complex)	IVa	*8632.6*	*16.4*
Moist Sedge, Dwarf Shrub Tundra		11,961.4	22.7
Moist Sedge, Dwarf Shrub Tundra	Va	*9076.3*	*17.2*
Moist Graminoid, Dwarf Shrub Tundra/ Barren Complex (frost-scar tundra complex)	Ve	*2885.1*	*5.5*
Moist Tussock Sedge, Dwarf Shrub Tundra	Vb	2.3	<0.1
Dry Dwarf Shrub, Crustose Lichens	Vc	689.0	1.3
Dry Dwarf Shrub, Fruticose Lichens	Vd	422.5	0.8
Dry Barren/Dwarf Shrub, Forb Grass Complex	IXb	250.6	0.5
Dry Barren/Forb Complex	IXc	21.5	<0.1
Dry Barren/Grass Complex	IXe	6.1	<0.1
Dry Barren/Dwarf Shrub, Grass Complex	IXf	4.7	<0.1
River Gravels/Beaches	Xa	308.8	0.6
Bare Peat, Wet Mud		565.6	1.1
Wet Mud	XIa	*532.4*	*1.0*
Bare Peat	XIc	*32.2*	*0.1*
Gravel Roads and Pads (and washouts)		84.1	0.2
Barren Gravel Outcrops	Xc	*4.8*	*<0.1*
Gravel Roads and Pads	Xe	*79.3*	*0.2*

[1] Taken from Noel and Funk (1999) with recent revisions and based on Level C (in parentheses) of *A hierarchical tundra vegetation classification especially designed for mapping in northern Alaska* (Walker 1983).

3.5 FISH

3.5.1 Diadromous and Freshwater Fish

The distribution of diadromous fish in the Beaufort Sea is primarily from two major population centers—the Mackenzie River system of Canada in the east and the Colville River and ACP systems of Alaska in the west (Craig 1984). Most of the major river systems along the 373-mi (600-km) coastline between the Mackenzie and Colville rivers originate in the Brooks Range and are termed "mountain streams" (Craig and McCart 1975). They are shallow throughout their courses and provide little over-wintering habitat except for that associated with warm-water perennial springs (Craig 1989), or rehabilitated mine sites. Dolly Varden char and Arctic grayling are the two principal species that inhabit these mountain streams, although lakes associated with these drainages may contain lake trout (*S. namaycush*) and grayling. Ninespine stickleback (*Pungitius pungitius*) are also prevalent in drainages within the western portion of the "mountain stream" range. While small runs of pink salmon (*Oncorhynchus gorbuscha*) occur in the Sagavanirktok and Colville rivers, and spawning populations of chum salmon (*O. keta*) inhabit the Colville and Mackenzie rivers (Craig and Haldorson 1986; Moulton 2001), the remaining salmon species consist of individuals from southern populations (e.g., Bering Sea) and are considered incidental visitors to the Beaufort Sea (Craig and Haldorson 1986).

Arctic cisco in the Alaskan Beaufort Sea originate from spawning grounds in the Mackenzie River system of Canada (Gallaway et al. 1983, 1989). Fry emerge by spring break-up in late May to early June and are swept downstream to coastal waters, where they begin feeding in the brackish waters near the Mackenzie Delta. Young-of-the-year are transported away from the Mackenzie region by wind-generated currents. In years with predominant easterly winds, some young-of-the-year are transported westward to Alaska by wind-driven coastal currents (Gallaway et al. 1983, Fechhelm and Fissel 1988, Moulton 1989, Fechhelm and Griffiths 1990, Schmidt et al. 1991, Underwood et al. 1995, and Colonell and Gallaway 1997). They arrive in the Prudhoe Bay area from mid-August to mid-September. In summers with strong and persistent east winds, enhanced westward transport can carry fish to Alaska's Colville River where they take up winter residence. They return to the Colville River every fall for overwintering until the onset of sexual maturity beginning at about age 7, at which point they migrate back to the Mackenzie River to spawn (Gallaway et al. 1983). The rearing Arctic cisco constitute one of the most abundant diadromous species found in the Alaskan Beaufort Sea, so much so that they support a very small commercial fishery in the Colville River and a subsistence fishery at the village of Nuiqsut (George and Kovalsky 1986; George and Nageak 1986; Moulton et al. 1990, 1992, and 1993; Moulton and Field 1988, 1991, and 1994; and Moulton 1994, 1995, 1996, and 1997).

3.5.2 Freshwater Habitat

The proposed Point Thomson export pipeline ROW area is located in the "mountain stream" zone of the North Slope. The principal freshwater habitat consists of coastal tundra ponds and lakes that have the potential to contain populations of ninespine stickleback (Ward and Craig 1974). Specifically, tundra streams located between the Staines River and East Badami Creek have been documented to contain ninespine stickleback (WCC and ABR 1983).

Rivers are the obligatory migratory routes for diadromous Dolly Varden char and ninespine stickleback in spring and late summer. Arctic grayling and round whitefish may also move down river in early summer to brackish-water estuaries and coastal areas while the nearshore region is still relatively fresh from the high runoff associated with breakup (Moulton and Fawcett 1984).

Over-wintering space is limited in North Slope rivers, particularly for Dolly Varden char, which require higher dissolved oxygen levels than arctic grayling. Craig (1989) postulated that the small amount of over-wintering habitat available to diadromous fish could be the most important factor limiting population size and causing cyclical fluctuations in species abundance. Dolly Varden char spawn in the fall and require perennial warm-water springs for successful wintering and reproduction. These springs provide fish with open-water habitat throughout the winter and prevent eggs from freezing (Craig 1984). Craig and McCart (1974) identified numerous Dolly Varden over-wintering areas in the Canning River located to the east of the Point Thomson development. Overwintering occurs to a more limited extent in the Shaviovik and Kavik rivers, both located to the west of the export pipeline ROW.

Freshwater species may enter deep-water lakes and isolated river channels during winter. There are two major independent streams that empty into Mikkelsen Bay east of the Shaviovik/Kavik River. Ward and Craig (1974) identified them merely as First Unnamed Stream East of Kavik River and Second Unnamed Stream East of Kavik River. More recently, Hemming (1996) referred to these to drainages as No Name River and East Badami Creek, respectively. This report adheres to the latter nomenclature. These streams are located west of the export pipeline tie-in point at Badami.

Fyke net surveys reported high numbers of ninespine stickleback in both East Badami Creek and No Name River, with catch rates ranging from 243 to 1,525 fish/day (Hemming 1996). A few juvenile Dolly Varden were collected in East Badami Creek ($N = 3$) and No Name River ($N = 9$) and a single grayling and a single round whitefish were reported for No Name River.
Visual surveys of six additional streams between East Badami Creek and the Staines River, ranging in length between 9 and 20 mi (15 and 32 km), found ninespine stickleback in all, and fourhorn sculpin in the estuarine portion of one (WCC and ABR 1983). Sampling results from East Badami Creek and No Name River (Hemming 1996) indicate that juvenile Dolly Varden, and possibly other diadromous species, may enter these streams to feed during early summer when stream flow is high. While these streams are located to the immediate west of the pipeline ROW, results from both could be indicative of other, moderately sized streams along the ROW.

Ward and Craig (1974) surveyed some of the larger lakes along the North Slope. Of these, nine were located between the Staines and Kavik Rivers and within 25 mi (40 km) of the coast. Numerous small tundra ponds and drainage streams characterize much of the coastal area between the East Badami Creek and the Staines River. These streams all support ninespine stickleback during summer, but most are shallow and freeze solid during winter; however the occasional deep pool might serve as a limited over-wintering area for a few ninespine stickleback (WCC and ABR 1983). These ponds and streams may be exploited to a greater degree during the open-water summer season. Ninespine stickleback and juvenile Dolly Varden char move up and down the coast in large numbers during summer and could enter and feed in any inland water body that is connected to the sea. Arctic grayling, broad whitefish and least cisco have also been reported to move between North Slope rivers during the summer (Hemming 1993, Moulton 1994, 1995, 1996, 1997; and George 2000). It is probable that fish utilize the smaller tundra ponds and streams between Mikkelsen Bay and the Staines River in a similar manner.

3.6 BIRDS

The Point Thomson area, located between the Badami development and the Staines River, has been the site of bird research periodically since the early 1980s. Wright and Fancy (1980) and WCC and ABR (1983) conducted limited ground-based studies of birds in the Point Thomson area. Additional research on bird populations and habitats was conducted to the east of the Point

Thomson area in ANWR during the 1002 Area studies conducted from 1984 to 1986 (Garner and Reynolds 1986) and along the Canning River (Martin and Moitoret 1981). More recently, bird studies were conducted inland from Point Thomson at the Yukon Gold exploratory ice pad (TERA 1993) and in the Badami area (TERA 1994). In recent years, LGL (Noel et al. 1999a, 2000), TERA (1999 and 2000), and the United States Fish and Wildlife Service (USFWS) (Petersen et al. 1999; Flint et al. 2001) have conducted aerial surveys for waterfowl, eiders, and ducks in the nearshore and tundra habitats of the Point Thomson area. Local residents (primarily Inupiaq Eskimos from Kaktovik) hunt birds in the Point Thomson region as an essential element of their subsistence lifestyle.

Johnson and Herter (1989) estimated that approximately 10 million birds of over 240 species occur in the Beaufort Sea region. Nearly all bird use on the ACP of Alaska is concentrated in the summer months (May–September) when snow-free nesting habitats, forage, and open water are available. Only a few species remain in the area during the winter, when food resources are scarce. Birds occurring in the region can be divided into three major species groups: waterfowl, tundra-nesting birds, and predatory birds. General abundance, distribution, and habitat use are addressed below for the species in each group, based largely on information from baseline studies at Point Thomson and elsewhere on the North Slope (Spindler 1976, Martin and Moitoret 1981, WCC and ABR 1983, Gardner et al. 1986, Garner and Reynolds 1986, Moitoret et al. 1996, Johnson and Herter 1989, Murphy and Anderson 1993, TERA 1993, Noel et al. 1999a and 2000, and Johnson et al. 2000). Most of these studies focused on study areas affected by current or future oil development, but they also include studies conducted in ANWR since the late 1970s.

3.6.1 Waterfowl & Other Waterbirds

The Point Thomson region supports 23 species of waterfowl (tundra swan, geese, eiders, and other ducks) and other waterbirds (loons, grebes, and seabirds) including seven species that breed in the area.

3.6.1.1 Tundra Swan

Tundra swans are common breeders on the ACP and have been recorded breeding in the Point Thomson area (Johnson and Herter 1989; Byrne et al. 1994; Johnson et al. 1999). Tundra swans have served as indicators of regional ecosystem health since they are sensitive to human disturbance and often nest at the same location year after year (King 1973 and Ritchie et al. 1990). Therefore, changes in their activities and distribution can provide a measure of the effects of development projects. On the North Slope, tundra swans nest at higher densities on major river deltas (Colville, Sagavanirktok, and Canning Rivers) than across the rest of the coastal plain. The Point Thomson region supports moderate numbers of tundra swans compared to other areas in northern Alaska (Rothe and Hawkins 1982 and Ritchie and King 2000).

Tundra swans inhabit the Point Thomson area from May through September (WCC and ABR 1983). Although the first swans arrive while the tundra is largely snow-covered (mid-May), most arrive 1 to 2 weeks later (Hawkins 1986 and Ritchie and King 2000). As snow melts, pairs move to breeding territories to nest by early June. After eggs hatch in early July, family groups remain together, but often range widely to find food (Johnson and Herter 1989). Before the young fly in mid- to late-September, adults become flightless (molt) for about 3 weeks. During this flightless period, swan broods are sensitive to disturbance. In the Colville delta area, non-breeding swans form large staging flocks (>100 birds), and have been found along river channels (East Channel of the Colville River and lower reaches of the Miluveach and Kachemach Rivers); data are lacking concerning non-breeding swan use of the Staines Canning River area. Fall staging on the coastal plain usually takes place during early to mid-September (Rothe et al. 1983, Smith et al. 1994 and Monda et al. 1994) and fall migration peaks in late September and early October (Johnson and Herter 1989).

Few surveys of nesting tundra swans have been conducted in the Point Thomson region, but nesting density (0.05 nests per square mile [nests/mi^2]) (0.08 nests per square kilometer [nests/km^2]) (Byrne et al. 1994) appears to be lower than has been recorded to the west (0.02–0.10 nests/mi^2 [0.03-0.17 nests/km^2] in the Kuparuk Oil Field, 0.08–0.21 nests/mi^2 [0.13-0.34 nests/km^2] on the Colville River delta, 0.23 birds/mi^2 [0.37 birds/km^2] on the Sagavanirktok River delta [Ritchie and King 2000]). Few swan nests have been found in the Point Thomson area. During ground searches in the Point Thomson area, WCC and ABR (1983) found two nests of tundra swans, both associated with lakes and ponds habitat types. Other swans were seen in June in wet strangmoor habitats (WCC and ABR 1983). During aerial surveys in 1994, Byrne et al. (1994) found that most nesting swans in the region were located between the Sagavanirktok River delta and Mikkelsen Bay and saw only seven swans (and no nests) between Mikkelsen Bay and the Staines River. No surveys have been conducted in the Point Thomson area specifically for brood-rearing swans, but LGL et al. (1999) reported densities of 0.28 swans/mi^2 (0.45 swans/km^2) during aerial surveys of tundra transects in the Point Thomson region. WCC and ABR (1983) recorded no tundra swans during the molting/brood-rearing period (25 July–15 August), but did observe small numbers of swans during staging (19 birds; 23–31 August) and fall migration (42 birds; 12–17 September) in the Point Thomson area. During aerial surveys, WCC and ABR (1983) also noted one staging area for tundra swans in a large lake near the coast southwest of Bullen Point (flocks of 20 and 28 swans with young noted during two aerial surveys). On the Canning River delta, brood-rearing swans occurred primarily in graminoid-marsh, graminoid-shrub-water sedge, and aquatic-marsh habitats (Monda et al. 1994). Other studies on the coastal plain have shown that tundra swans occur frequently in habitats supporting the emergent grass *Arctophila fulva*, which is a primary food for adults and young (Bergman et al. 1977; Derksen et al. 1981). Brood-rearing tundra swans prefer aquatic habitats because they provide food and escape cover, especially for the young.

3.6.1.2 Geese

Four species of geese (greater white-fronted goose, Canada goose, brant, and snow goose) regularly nest on the ACP and have been recorded in the Point Thomson region (Johnson and Herter 1989 and WCC and ABR 1983) The distribution of each species differs across the coastal plain and is influenced by their nesting habits. Greater white-fronted and Canada geese nest in isolated pairs on the tundra or on small islands in lakes and ponds. In contrast, brant and snow geese nest primarily in colonies at traditional sites, ranging from a few to several hundred pairs.

The greater white-fronted goose is the most common goose on the ACP, becoming less common east of Prudhoe Bay (Johnson and Herter 1989). Greater white-fronted geese are present on the coastal plain from approximately mid-May to mid-September. They arrive when open tundra appears and begin nesting within 1 to 2 weeks, usually by late May (Rothe et al. 1983 and Johnson and Herter 1989). Eggs hatch in late June and early July. Before the young can fly, adults (breeding and nonbreeding) molt and are flightless for 2 to 3 weeks. During brood-rearing, family groups form large flocks near deep lakes that provide protection from predators. Once adults and young can fly, they form large staging flocks before the migration, which begins in mid-August and ends about mid-September (Johnson and Herter 1989).

Greater white-fronted geese may breed in low numbers in the Point Thomson region, but were not recorded as nesting by WCC and ABR (1983) or Wright and Fancy (1980). Small numbers of greater white-fronted geese were seen during spring arrival and nesting, but they were most numerous during the staging period, suggesting that the area is more important for staging than nesting (WCC and ABR 1983). This conclusion is supported to some extent by the relatively large density (15.0 birds/mi^2 [24 birds/km^2]) of geese seen during aerial surveys in August and September (LGL et al. 1999).

The Canada goose has a patchy distribution across the ACP, with highest densities in the Prudhoe Bay area (Johnson and Herter 1989). Breeding phenology is similar to that described previously for the greater white-fronted goose. In the Point Thomson region, Canada geese are the primary nesting goose species (Wright and Fancy 1980 and WCC and ABR 1983) and have been commonly observed during the breeding season (WCC and ABR 1983). Eight Canada goose nests were located during ground searches in the Point Thomson area in 1983, all in lake and pond habitat type (WCC and ABR 1983). Wright and Fancy (1980) found two Canada goose nests, one in each of their plots (drilling site south of Point Gordon/control site south of Point Sweeny).

The estimated nesting density (3.9 nests/mi^2 [6.3 nests/km^2]) WCC and ABR 1983) in the Point Thomson area was the highest recorded for study sites from Point Thomson to the Prudhoe Bay area (Table 3-5). During aerial surveys of tundra transects during staging in August–September 1998, LGL et al. (1999) reported densities of 4.2 birds/mi^2 (6.8 birds/km^2). Brant nest in low numbers across most of the coastal plain, with larger nesting colonies found on major river deltas, such as those of the Colville, Kuparuk, and Sagavanirktok Rivers (Johnson and Herter 1989 and Sedinger and Stickney 2000). Brant occur in the Point Thomson region from late May through late August (WCC and ABR 1983). They arrive on the coastal plain in early June and move to nesting colonies soon afterwards (Kiera 1979 and Rothe et al. 1983). Hatching begins in late June or early July and brant form large brood-rearing flocks shortly thereafter. Brant depart the coastal plain soon after the young can fly, usually by mid-August.

Table 3-5 Nesting Density (Nests/mi^2) of Birds in the Point Thomson Region and Adjacent Areas on the Arctic Coastal Plain, Alaska

SPECIES	POINT THOMSON (1983)	YUKON GOLD (1993)	CANNING RIVER DELTA (1979–1980)	BADAMI (1994)	KADLER-OSHILIK (1994)	SAGAVAN-IRKTOK RIVER DELTA (1981)	POINT MCINTYRE REFERENCE AREA (1981–1992)
Red-throated Loon				0.8			0.3
Pacific Loon					2.6		3.9
Greater White-fronted Goose					0.8		2.8
Canada Goose	3.9				3.4		0.3
Northern Pintail							0.3
Spectacled Eider					0.8		0.5
King Eider			2.1	1.8	1.8	4.4	3.4
Common Eider	3.9						
Long-tailed Duck	3.9	0.8	2.1	0.8	3.4	4.4	3.4
Willow							0.3

Ptarmigan							
Rock Ptarmigan			3.9	0.8			0.8
Black-bellied Plover				0.8	1.8	4.4	1.6
American Golden-Plover		2.6	3.9	7.0	4.4	8.5	7.0
Sanderling							0.3
Semipalmated Sandpiper		6.0	25.9	41.4	23.3	30.3	32.4
Western Sandpiper							0.3
White-rumped Sandpiper							1.6
Baird's Sandpiper	50.5			2.6		8.5	1.8
Pectoral Sandpiper	27.2	18.9	31.9	23.3	31.1	4.4	22.5
Dunlin			8.0	8.5	10.4		19.4
Stilt Sandpiper				3.4	3.4		1.8
Buff-breasted Sandpiper			6.0			4.4	2.3
Long-billed Dowitcher	7.8			1.8			1.0
Red-necked Phalarope		1.8	14.0	2.6	8.5	4.4	2.3
Red Phalarope	7.8	3.4	47.7	6.0	19.9	13.0	17.6
Parasitic Jaeger							0.3
Lapland Longspur	62.2	38.1	71.5	90.7	64.8	47.4	38.3
Total Density	167.1	73.3	216.9	192.9	180.3	134.2	166.3
Waterfowl	11.7	0.8	4.2	3.4	12.7	8.8	14.8
Shorebird	93.2	32.6	137.3	97.4	102.8	78.0	111.9
Passerine	62.2	38.1	71.5	90.7	64.8	47.4	38.3
Other Birds	0	0	3.9	0.8	0	0	1.3
Number of Species	8	7	11	15	15	11	26
Source	WCC and ABR (1983)	TERA (1993)	Martin and Moitoret (1981)	TERA (1994) in BP (1995)	TERA (1994) in BP (1995)	Troy (1988)	TERA (1993)

Note: Methods varied among studies but all involved nest searches within transects or plots; for multiple-year studies, average densities are presented.

In the Point Thomson area, brant have been found nesting (1 nest) on an island in the Staines River delta (Ritchie et al. 1991). Small numbers of brant have been recorded nesting at locations west of the ROW on the Shaviovik and Kadleroshilik River deltas and on Tigvariak Island (Ritchie et al. 1990 and 1991; Stickney et al. 1992 and 1993). Nesting habitats of brant have been described and include salt-killed tundra, aquatic sedge with deep polygons, brackish water, salt marsh, nonpatterned wet meadow, and wet sedge-willow meadow (Johnson et al. 1999).

No brood-rearing brant have been recorded in the Point Thomson area, but small flocks have been seen on deltas of the Kadleroshilik and Shaviovik Rivers and on Tigvariak Island to the west of Badami (Ritchie et al. 1990, 1991; Stickney et al. 1992, 1993; Noel and Johnson 1997; Noel et al. 1999c). WCC and ABR (1983) reported small numbers (407 birds) of brant in the Point Thomson area during the molting/brood-rearing period (mid July–mid August). Brood-rearing (and molting) flocks have a strong affinity for coastal and salt-affected habitats because brant feed primarily on *Puccinellia phryganodes* and *Carex subspathacea*, which are found only in saline habitats (Kiera 1979). This habitat type is somewhat limited in the Point Thomson area, but small acreages (<2% of total mapped acreage) of this type can be found near Point Thomson and at scattered locations between the Staines River and Mikkelsen Bay. The distance of these habitats from known breeding colonies limits their availability for brood-rearing flocks, although they may be used by birds during staging and migration. Large numbers of brant have been recorded moving westward through the Point Thomson area during the staging and fall migration periods, 5959 and 2526 birds, respectively (WCC and ABR 1983). Small numbers of brant (0.36 birds/mi^2 [0.58 birds/km^2]) were recorded during aerial surveys of lagoon transects in the Point Thomson area during August–September 1998 (LGL et al. 1999).

Snow Geese nest in several colonies and in scattered pairs across the ACP; generally west of the Sagavanirktok River delta (Derksen et al. 1981, Simpson et al. 1982, Johnson 2000, and Ritchie et al. 2000). No breeding colonies have been reported in the Point Thomson region (Wright and Fancy 1980 and WCC and ABR 1983), but WCC and ABR (1983) did report sighting of four snow geese during spring arrival (early June). The nearest nesting colony closest to the proposed ROW is located well to the west of Badami, at Howe Island, on the Sagavanirktok River delta. This site has supported limited numbers of nesting snow geese in recent years, due to disruption of nesting by predator/scavengers (Noel et al. 1999c and Noel and Johnson 2001a and 2001b).

Snow geese arrive in coastal nesting areas in late May or early June and young hatch during late June, although breeding phenology can be affected by late snow-melt in nesting areas. Brood-rearing snow geese have been seen in most years west of the Point Thomson proposed export pipeline ROW in the vicinity of the Shaviovik River delta and Tigvariak Island (Noel and Johnson 1997 and Noel et al. 1999c). During autumn migration, large numbers (150,000–450,000) of snow geese stage in the eastern coastal plain of ANWR for short periods in early-mid September (Robertson et al. 1997). However, LGL et al. (1999) did not record any snow geese during aerial surveys of tundra and lagoon transects in the Point Thomson area in August–early September 1998, and WCC and ABR (1983) did not record snow geese during staging or fall migration in the Point Thomson area.

3.6.1.3 Ducks

Ducks on the ACP of Alaska can be separated into three general groups: Arctic breeders (e.g., eiders and long-tailed duck [oldsquaw]); breeders on the edge of their range (e.g., green-winged teal, northern pintail, greater scaup, northern shoveler, American wigeon, and red-breasted merganser); and non-breeders (e.g., scoters and common goldeneye).

Of the 13 species of ducks recorded in the Point Thomson region, four are confirmed breeders: the long-tailed duck, and spectacled, king, and common eiders (Tables 4-7 and 4-8) (Wright and Fancy 1980, WCC and ABR 1983, and TERA 1993). King eiders were the most abundant eider seen during aerial surveys for eiders in the Point Thomson region (Byrne et al. 1994 and TERA 1999 and 2000). Northern pintails are common in the Point Thomson area and probably nest in the area, but no nests were found by Wright and Fancy (1980), WCC and ABR (1983), or TERA (1993). Other duck species could potentially be abundant in the Point Thomson region during years when they are displaced by drought from the prairie regions of North America (Derksen and Eldridge 1980). Common eiders nest primarily on the coast and on offshore barrier islands, but breeding pairs also have been recorded at inland sites in the Point Thomson area (TERA 1999 and 2000), suggesting some nesting may occur there. Common eiders regularly nested on the barrier islands between Mikkelsen Bay and the Staines River, with a yearly average of 130 nests total found among the barrier islands searched (Moitoret 1998 and Noel et al. 1999c and 2001). Of the seven major barrier islands in the Point Thomson region, Pole, Alaska, Northstar, and Duchess islands supported the most nesting common eiders (Moitoret 1998 and Noel et al. 1999c).

Like most waterbirds, ducks (including eiders) occur in the Point Thomson region between May and September, when tundra ponds are ice-free. Ducks arrive on the tundra in mid- to late May, begin nesting within 1 to 2 weeks, and depart by late August (Rothe et al. 1983 and North et al. 1984). Male king eiders and long-tailed ducks leave the breeding grounds by mid-June after females commence incubation (Rothe et al. 1983). Duck broods first appear in early to mid-July, and most young can fly by late August (Rothe et al. 1983 and North et al. 1984). Eider broods probably remain in the area longer than other duck species, because their larger size requires more time for young to fledge (become capable of flight).

Information on nesting habitats of ducks in the Point Thomson region is relatively sparse, but WCC and ABR (1983) found breeding pairs in moist and wet tundra habitats and lakes without emergent vegetation. During brood rearing, ducks on the coastal plain primarily use aquatic habitats, particularly those with emergent vegetation. Brood-rearing long-tailed ducks use aquatic sedge and grass marshes, small lakes, and river channels; while molting groups occur more often on large, deep open lakes, tapped lakes, and coastal lagoons. Northern pintails generally use aquatic sedge and grass marshes, flooded tundra, brackish ponds, and salt marshes during brood rearing. In general, all aquatic habitats in the Point Thomson region likely receive some use by ducks for nesting, brood rearing, and foraging.

During the molting and post-molting periods, long-tailed ducks are abundant along the mainland and in the lagoon system between the Staines River and Mikkelsen Bay, but are less commonly found on the inland tundra (Figures 3-2A and 3-2B). Relative abundance of long-tailed ducks varies among locations along the mainland shore and in the barrier island system of Lion Bay. Shorelines immediately east of Point Thomson to a point near Point Gordon received the greatest use during both the molting and post-molting periods, while the shorelines to the east and west of this area were used less (Noel et al. 1999a and 2000 and Flint et al. 2001). The proposed ROW runs immediately inland of these two points. Of all the surveys flown, the highest mean densities of long-tailed ducks during both the molting and post-molting periods were recorded on and immediately adjacent to the barrier islands (Noel et al. 1999a and 2000 and Flint et al. 2001).

3.6.1.4 Loons

Three species of loons—yellow-billed, Pacific, and red-throated—breed on the ACP of Alaska. Common loons and two species of grebes are casual visitors or irregular breeders, respectively

Yellow-billed loons are uncommon breeders on most of the ACP.. No nests of yellow-billed loons have been documented in the Point Thomson area, but WCC and ABR (1983) indicated several loons during fall staging (1 bird) and migration (7 birds). Wright and Fancy (1980) also recorded yellow-billed loons at their two study plots near Point Gordon and Point Sweeny, located to the north along the proposed ROW. Low densities (mean density = 0.05 birds/mi^2 [0.08 birds/km^2]) of yellow-billed loons were recorded during aerial transects along the barrier islands of Lion Bay in August–September 1998 and 1999 (LGL et al. 1999 and Noel et al. 2000).

Pacific loons are common breeders across the entire coastal plain (Johnson and Herter 1989). They were the most abundant loons observed in the Point Thomson region in 1982 and have been recorded as breeding in the area (WCC and ABR 1983). Pacific loons occur in the project area from early May through September. Pacific loons arrive on the coastal plain in late May as open water appears in river channels and on tundra lakes and ponds; they move to nesting lakes as ice disappears in early to mid-June. After the young hatch in mid-July, they tend to remain in the nesting lake, or move to adjacent lakes. The time required for juveniles to fledge varies among loon species, with the larger yellow-billed and Pacific loons requiring more time than the smaller red-throated loon. Fall migration of loons peaks during early September along the Beaufort Sea (Johnson and Herter 1989), but family groups (adults with young) do not depart until the young can fly, which may be as late as mid-September.

The Pacific loon was the most abundant loon species recorded during aerial surveys in August–September 1998 on tundra transects and second-most abundant on the barrier islands transects in the Point Thomson area (mean density = 0.39 birds/mi^2 [0.63 birds/km^2]) and 0.02 birds/mi^2, [0.03 birds/km^2]) respectively) (LGL et al. 1999). In 1999, Noel et al. (2000) found that Pacific loons predominated in the lagoon system of the Point Thomson area during August–September surveys. Limited information on habitat use by Pacific loons in the Point Thomson area indicates use of lakes and ponds with and without emergent vegetation, and also wet low-centered polygons (probably in standing water) (WCC and ABR 1983). Pacific loons feed primarily on aquatic invertebrates available in their breeding lakes (Bergman and Derksen 1977, North 1986, and Kertell 1994) and nearshore marine waters (Andres 1993).

The red-throated loon is a common breeder on the ACP, including the Point Thomson region (Johnson and Herter 1989 and Johnson et al. 1999a). Red-throated loons were less abundant than Pacific loons during all periods of the breeding season in the Point Thomson area (WCC and ABR 1983). Two red-throated loon nests were found in the Point Thomson area, both in the lake and pond habitat type (WCC and ABR 1983).

The breeding cycle and habitat use of red-throated loons differs from that of other loons. Red-throated loons arrive on the coastal plain later than the other species, usually not until early June when open water appears in tundra ponds. The timing of breeding events, however, is similar to that of yellow-billed and Pacific loons. Red-throated loons nest on smaller (often <3 acres [1.2 ha]), shallower ponds than do the other species (Johnson and Herter 1989 and Dickson 1994; McIntyre 1994). On the coastal plain, red-throated loons use both sedge and grass marshes, but they also use basin wetland complexes, especially during brood rearing (Bergman et al. 1977 and Derksen et al. 1981).

In contrast to the other loons, who do most of their feeding in their nesting lakes, red-throated loons fly to nearshore marine waters to hunt fish for their young (Bergman and Derksen 1977). This behavior may account for the relatively greater abundance of red-throated loons compared to pacific loons in the barrier islands and lagoons in the Point Thomson area during August–September (0.21 birds/mi^2 [0.34 birds/km^2] and 0.10 birds/mi^2 [0.16 birds/km^2], respectively) (LGL et al. 1999). Nesting lakes are not used for feeding, probably because few fish survive when these shallow lakes freeze to the bottom in winter.

3.6.2Tundra-Nesting Birds

Tundra-nesting birds of the Point Thomson region include shorebirds, ptarmigan, and songbirds. These bird species nest primarily in terrestrial habitats, rather than in association with aquatic habitats.

3.6.2.1 Shorebirds

Shorebirds are present in the Point Thomson region from May to September. They begin to arrive in late May, and most are present by mid-June. Nesting usually begins 7 to 10 days after arrival. The young hatch during late June to mid-July, and fledge 3 to 4 weeks later. After the breeding season, many shorebirds move to the coast to feed in shoreline habitats before beginning migration in August (Rothe et al. 1983, Andres 1989 and 1994, and Smith and Connors 1993).

Of the 21 species of shorebirds recorded in the Point Thomson region, 10 are confirmed breeders, based on nests or broods Ground-based studies of shorebirds have been limited in the Point Thomson region but do include surveys for breeding shorebirds (WCC and ABR 1983). WCC and ABR (1983) found that the most common nesting shorebirds in the Point Thomson region were the Baird's sandpiper, pectoral sandpiper, red phalarope, and long-billed dowitcher. Both the diversity and density of shorebirds on the Point Thomson region during the breeding season were less than those found elsewhere on the ACP (Table 3-5).

Shorebirds breeding on the Point Thomson region use many habitats for nesting and brood-rearing. Plovers nested on the drier upland habitats, and phalaropes and other sandpiper species nested in wetter tundra habitats, including wet sedge meadows, wet nonpatterned tundra, and aquatic sedge and grass marshes (WCC and ABR 1983). During brood rearing, shorebirds move to tundra and aquatic habitats adjacent to the nest sites. After the young fledge, many shorebirds form large feeding flocks, often of mixed species, that tend to congregate in coastal habitats (Smith and Connors 1993). Large movements of shorebirds to coastal habitats were not seen in the Point Thomson area, although use of coastal marshes has been observed (WCC and ABR 1983). Shorebirds with broods were seen using lakes with and without emergent vegetation, wet strangmoor, and coastal marshes. These habitats, along with the others used for breeding activities, are the primary source of food (insects and other small invertebrates) for the birds (Andres 1989 and Johnson and Herter 1989). The coastal shift in habitat use by shorebirds continued during the staging and fall migration periods in the Point Thomson area (WCC and ABR 1983).

3.6.2.2 Ptarmigan

Rock and willow ptarmigan are widespread on the ACP, particularly inland from the coast (Johnson and Herter 1989). Although both species were seen in the Point Thomson area, only rock ptarmigan were confirmed as breeding (Wright and Fancy 1980 and WCC and ABR 1983)). Most rock ptarmigan were seen in the moist non-patterned habitats in the area (WCC and ABR 1983). A few ptarmigan of either species may overwinter in the Point Thomson region, but most winter in the foothills of the Brooks Range (Johnson and Herter 1989).

3.6.2.3 Songbirds

Songbirds occur on the ACP only during summer; with the exception of two redpoll species. Most songbirds winter in temperate and tropical regions of the Americas or southern Asia. Of the eight species recorded in the Point Thomson area, only four are confirmed breeders (Tables 4-7 and 4-8). The other species occur in the region during migration or as summer vagrants. Overall, nest densities of songbirds in the Point Thomson area are near the lower end of nesting densities reported for other locations on the ACP. The most abundant breeding species in the Point

Thomson region is the Lapland longspur Lapland longspurs were found nesting in most habitat types in the Point Thomson area, but the majority of nests were found in moist habitats (WCC and ABR 1983), wet sedge meadows, and *Dryas* tundra (Wright and Fancy 1980). In the Prudhoe Bay area, the highest densities of Lapland longspur nests occur in polygonized wet and moist meadows (Troy 1988).

3.6.3 Predatory Birds

Predatory birds recorded in the Point Thomson region include raptors (seven species), gulls (three species), jaegers (three species), arctic tern, and common raven). Except for the common raven, which is a year-round resident, all of these species winter farther south (Johnson and Herter 1989).

3.6.3.1 Raptors

None of the raptors (eagles, hawks, falcons, and owls) that occur on the ACP is a regular breeder in the Point Thomson region. Snowy and short-eared owls are locally common breeders on the coastal plain during years when small mammals are abundant (Johnson and Herter 1989). They probably nest in the project area during those times. Most raptors that breed regularly in northern Alaska are more common inland than on the outer coastal plain (Johnson and Herter 1989). Many raptors seen near the coast are juveniles, failed breeders, or migrants. Immature golden eagles frequent the coastal plain in summer (Young et al. 1995). A few peregrine falcons and rough-legged hawks do nest in coastal areas and may be attracted to man-made structures for nesting (Ritchie 1991). Rough-legged hawks have nested on an airport tower at the Bullen Point Dewline site (R. J. Ritchie, ABR, Inc., pers. com.). Thus, although the Point Thomson area is used by raptors, it is not an important nesting area.

The Arctic peregrine falcon (*Falco peregrinus tundrius*) was removed from the threatened list by the USFWS on 5 October 1994 (59 FR 50796), and the species has now completed the 5-year monitoring period that follows delisting, when it was treated as a species of concern. Currently, the Arctic peregrine falcon receives no special considerations from regulatory agencies based on the Endangered Species Act, but still receives some protections under the Migratory Bird Treaty Act (16 U.S.C. 703-712). Peregrines generally have been considered as infrequent visitors to the coastal plain (Pitelka 1974 and Johnson and Herter 1989) and regular breeders inland (Cade 1960 and Pitelka 1974). However, recent surveys in the National Petroleum Reserve–Alaska suggest that individuals from the increasing population of peregrines have selected more marginal habitats including low mud bluffs on the ACP (Ritchie and Wildman 2000; Wildman and Ritchie 2000).

Only a few Arctic peregrine falcon sightings have been reported in the Point Thomson area: one near Point Sweeny in 1980 (Wright and Fancy 1980) and one seen during late summer in 1983 (WCC and ABR 1983). Arctic peregrine falcon use of the area probably includes occasional hunting forays during summer by adults, movements of young birds after leaving the nest, and transient and migratory use. They do not nest in the coastal region of the proposed pipeline ROW.

3.6.3.2 Other Species

Other predatory birds that occur in the project area include gulls, jaegers, and the Arctic tern. Two species of gulls (glaucous and Sabine's) breed in the region (both are common to uncommon breeders on the ACP (Johnson and Herter 1989). Both species nest either as isolated pairs or in small colonies. Glaucous gulls also nest on the barrier islands offshore of the Point Thomson area (Noel et al. 1999b).

All three species of jaegers occur in the Point Thomson area, but only the parasitic jaeger is a regular breeder (see Table 3-5). Pomarine jaegers are common only during spring migration (early

June) in the Point Thomson area (WCC and ABR 1983). Long-tailed jaegers were found nesting in the Kadleroshilik area (Nickles et al. 1987 and Fields et al. 1988) and may nest occasionally elsewhere in the Point Thomson region. Little is known about nesting habitats for jaegers in the Point Thomson area.

Arctic terns are common breeders across the coastal plain and have been found nesting on the barrier islands in the Point Thomson area (Johnson and Herter 1989; Noel et al. 1999b). WCC and ABR (1983) recorded arctic terns during most periods of the breeding season.

The breeding phenology for all of these birds is similar (May–September) to that described for other species, except that gulls arrive somewhat earlier on the coastal plain than the other species (Johnson and Herter 1989). Food habits differ among species, but all species range widely over the tundra in search of food. Glaucous gulls and jaegers eat small birds, small mammals, and the eggs and young of waterfowl, other waterbirds, and shorebirds. Parasitic and long-tailed jaegers prey on eggs of waterfowl (ducks, geese, and swans) and hunt shorebirds and other small birds (Johnson et al. 1999b, 2000). Sabine's gulls and arctic terns feed on aquatic invertebrates and small fish in deep open lakes, deep ponds with emergent vegetation, and ponds in basin wetland complexes (Rothe et al. 1983). Gulls, jaegers, and terns occur throughout the Point Thomson area, given their broad habitat use and diverse prey.

Common ravens are uncommon residents on the ACP, where they closely associate with human habitations (Johnson and Herter 1989). Ravens occasionally nest near the coast, primarily on buildings and other structures, including oilfield facilities (Johnson and Herter 1989 and Ritchie 1991). Common ravens occur in the Point Thomson area, and one apparently active nest was found at the Bullen Point Dewline site in 1994 (Day et al. 1995). Small numbers of ravens use the Point Thomson area during summer (WCC and ABR 1983). Common ravens are the earliest breeding species on the coastal plain; nesting begins by early April and young fledge by mid-June (Johnson and Herter 1989). Ravens range widely across the tundra in search of food (bird eggs, small mammals, and carrion) and have been observed taking eggs of waterbirds (ducks or shorebirds) in the oil fields (ABR, unpublished data).

3.7 MARINE MAMMALS

The Beaufort Sea provides habitat for eight species of marine mammals. These include cetaceans (bowhead, gray, and beluga whales), pinnepeds (ringed, bearded, spotted seals, and walrus), and polar bear. Specific discussions on marine mammals in the entire Point Thomson Unit area can be found in Section 4.9 of the ER. Descriptions of marine mammals in the Beaufort Sea have also been presented in Final Environmental Impact Statements for Lease Sales 97, 109, 124, 144, and 170 (MMS 1987a, 1987b, 1990a, 1996a and 1997a, respectively). Polar bears are the only marine mammal expected to be in the vicinity of the proposed onshore export pipeline ROW and are therefore discussed below. Ringed seals may be encountered in waters immediately offshore of the proposed ROW and are also discussed in this section.

3.7.1 Polar Bears

Polar bears (*Ursus maritimus*) (Inupiaq name Nanuq) have a circumpolar distribution throughout most ice-covered seas of the Northern Hemisphere, and are common within 200 mi (322 km) of the arctic coast of Alaska (Amstrup and DeMaster 1988). Within this range, polar bears are divided into five largely discrete populations. The range of the Southern Beaufort Sea population extends from the northwest Chukchi Sea to Cape Bathurst, Canada (Lentfer 1974 and Amstrup et al. 1986) and encompasses the area proposed for the Point Thomson Gas Cycling Project. This population was estimated at 1500-2000 bears in 1994, and has grown at a mean annual rate of 2.4% over the last 20 years (Amstrup 1995). Population density currently appears to be stabilizing or increasing slightly since it is believed to be approaching the carrying capacity of the environment (USFWS 1995).

In the proposed project area, polar bears are present near the coast during the ice-covered period and infrequently during the summer. Polar bear distribution is influenced greatly by prey abundance (particularly ringed seal) on seasonal ice (Smith 1980). As the ice-pack spreads southward in the fall, polar bears move with it, appearing along the Beaufort Sea coast from September to October (Lentfer 1972). Polar bears generally prefer areas of heavy offshore pack ice (Stirling 1988), and adult males usually remain there, rarely coming ashore (Amstrup and DeMaster 1988). During winter and spring, polar bears tend to concentrate in these areas of shore-fast ice with deep drifted snow along pressure ridges, at the floe edge, and on drifting ice with at least 7 to 8 in (18 to 20 cm) of ice cover (Stirling et al. 1975 and 1981). The greatest densities occur in the latter two categories, presumably because these habitats offer bears greater access to seals.

In spring and early summer, polar bears move north with the ice as it recedes from coastal areas. They remain on the drifting pack ice during the summer months. Little has been published about their offshore distribution during this season. Polar bears are typically on land only during the winter denning season. In addition to denning females, females with cubs and subadult males occasionally come ashore. Females with young cubs may hunt in fast-ice areas.

The breeding season is from April through June when both males and females are active on the sea-ice. During the breeding season in late March through May, males actively seek out females by following their tracks on the sea-ice. Bears are polygamous, and the male remains with a receptive female a relatively short time and then seeks another female. Gestation lasts about eight months. Pregnant females enter dens in October or November and give birth in December or January to between one and three cubs. Bears (mother and cubs) emerge from their dens in late March or April when cubs weigh about 15 lbs (6.8 kg), and move out onto the pack ice (Lentfer and Hentsel 1980 and Amstrup and Gardener 1994).

They make short trips to and from the open den for several days as the cubs become acclimated to outside temperatures. They then start traveling on the drifting sea-ice. Females can breed again at about the same time they separate from their young, so normally they can produce litters every third year. Cubs usually stay with their mothers until they are 1½ to 2½ years old, although some may remain into their third or fourth year (Stirling et al. 1975). Adult males and non-pregnant females are active all year using dens only as temporary shelter during severe weather.
Between 1981 and 2001, 49% of polar bear dens found in coastal Alaska and neighboring Canada were on land, barrier islands, or fast-ice (Amstrup, unpublished data). Figure 3-3 shows the known polar bear den sites in the Point Thomson area. The two onshore den sites located within the Point Thomson Unit immediately west of the proposed facilities were active dens in 2001. The other locations have been used historically over the period 1988-1999.

Bears excavate maternity dens in compacted snowdrifts adjacent to bluffs, barrier islands, and other areas of topographic relief (Amstrup and DeMaster 1988). Denning females often use stable sea-ice on the shoreward side of the barrier islands. Flaxman, Pingok, Cross, Cottle, Thetis and other barrier islands in the Beaufort Sea are known to support maternity dens.

Most terrestrial dens are located within a few mi of the coast, although dens as much as 30 mi (48 km) inland have been reported (USFWS 1995). A total of 10 maternal dens have been documented between 1981 and winter of 2000/2001 in the coastal areas between the Canning and the Shaviovik Rivers. Seven of these dens were located on Flaxman Island, one in the Canning River Delta, two along the coast west of Point Thomson, and one on land fast ice offshore of Point Thomson. Flaxman Island would be the only predictable denning area in this region (Ampstrup, unpublished data). The number of polar bears denning in the project area within a particular year cannot be estimated with confidence. However, the proportion of bears denning on land in the Beaufort Sea region appears to be increasing, probably because of hunting restrictions beginning in the early 1970s (Stirling and Andriashek 1992 and Amstrup and Gardner 1994).

Polar bears occasionally congregate on the barrier islands in the fall and winter because of available food such as bowhead carcasses and favorable environmental conditions. In November 1996, a congregation of 28 bears was observed near a carcass on Cross Island, and another 11 were observed within a 2 mi (3.2 km) radius of a carcass on Barter Island (Kalxdorff 1998).

Polar bears are extremely curious and opportunistic hunters, and they have been known to approach facilities in search of food. The main food of polar bears in the Alaskan Beaufort Sea is the ice-inhabiting ringed seal. Bears capture seals by waiting for them at breathing holes and at the edge of leads or cracks in the ice. They also stalk seals resting on top of the ice and catch young seals by breaking into pupping chambers in snow on top of the ice in the spring. Bears prey to a lesser extent on bearded seals, walrus, and beluga whales. They also feed on carrion, including whale, walrus, and seal carcasses they find along the coast. They occasionally eat small mammals, bird eggs, and vegetation when other food is not available. A keen sense of smell, extremely sharp claws, patience, strength, speed, and the camouflaging white coat aid in procuring food (ADF&G Wildlife Notebook Series, Jan 31, 2001).

Cubs weigh between 1 and 2 lbs (0.5-0.9 kg) at birth. An extremely large adult male may weigh 1,500 lbs (680 kg). Most mature males weigh between 600 and 1,200 lbs (273-545 kg), and are between 8 and 10 ft (2 to 3 m) in length. Mature females weigh 400 to 700 lbs (182 to 318 kg). Bears in the wild have been recorded as old as 32 years but most typically do not live beyond 25 years (ADF&G 2001).

Polar bears live in areas under the jurisdiction of five nations--Russia, Norway, Denmark, Canada, and the United States--and also on the high seas where jurisdiction is not clearly defined. Representatives of the five polar bear nations prepared an international agreement on conservation of polar bears in November 1973. The pact was ratified in 1976. It allows bears to be taken only in areas where they have been taken by traditional means in the past and prohibits the use of aircraft and large motorized vessels. The agreement has created a high seas polar bear sanctuary but does not prohibit hunting from the ground using traditional methods.

In Alaska prior to the late 1940s, nearly all polar bear hunting was by Eskimos with dog teams. Sport hunting, sometimes with the use of aircraft, started in the late 1940s and continued through 1972. In 1972, the state of Alaska prohibited the use of aircraft in polar bear hunting. With the passage of the Statehood Act, Alaska began a polar bear management program. State regulations required sealing of skins, provided a preference for subsistence hunters, and protected cubs and females with cubs (ADF&G 2001).

The federal Marine Mammal Protection Act (MMPA) of 1972 transferred management authority from the State to the federal government and placed a moratorium on hunting of marine mammals by people other than Alaskan Natives. This resulted in a reduced total harvest, but an increase in the proportion of female bears and cubs. The MMPA includes provisions that allow for waiver of the moratorium or transfer of management authority back to states. At intervals since 1972, the

State of Alaska has made efforts at regaining polar bear management. State management could allow a resumption of sport hunting and produce increased economic opportunities in coastal rural communities. For a variety of reasons, efforts to regain State management have been discontinued. Polar bear meat, other than that of males in the rut, is quite palatable when boiled. It is a favored subsistence food in some areas.

The stocks of polar bear in Alaska are shared with other nations. In 1988, the North Slope Borough Department of Wildlife Management (representing Alaskan Natives) and the Inuvialuit Game Council (representing Canadians) signed an agreement to provide for coordinated management of the Beaufort Sea polar bear stock (ADF&G 2001).

3.7.2 Ringed Seals

Seal surveys were conducted for the Liberty Island project area in spring 1985, 1986, and 1987, and resumed in 1997 (LGL et al. 1998, Frost et al. 1997, and LGL et al. 1997 and 1998), reported small numbers of ringed and bearded seals near the project area in the spring. Spotted seals were not observed during these aerial surveys. Boat-based marine mammal monitoring for an Ocean-Bottom Cable 3-D seismic survey from 25 July to 18 September 1996, in an area to the west of the proposed Point Thomson Gas Cycling Project area, documented the presence of all three seals, with 92% ringed seals, 7% bearded seals, and 1% spotted seals (Harris et al. 1997). BP Exploration-Alaska (BPXA)-sponsored aerial surveys conducted around Liberty Island (west of the proposed Point Thomson Area Cluster Development site) in May/June 1997 over land-fast ice, found ringed seals widely distributed throughout the Liberty area. No other seal species were encountered (LGL et al. 1998).

Ringed seals (*Phoca hispida*) (Inupiaq name Natchiq) are year round residents in the Beaufort Sea and are the most common seal offshore of the proposed development area. The worldwide population of ringed seals is estimated to be 6-7 million (Stirling and Calvert 1979), with the Alaskan portion being 1-1.5 million (Kelly 1988 and Small and Demaster 1995) in the Bering, Beaufort, and Chukchi Seas. Roughly 80,000 ringed seals can be found in the Beaufort Sea during the summer and 40,000 during the winter (Frost and Lowry 1981). During winter and spring, ringed seals spend much of their time on land-fast ice and offshore pack ice. They maintain breathing holes throughout the winter in ice up to 6 ft (1.8m) thick and dig multiple haul-out shelters and nursery lairs beneath the snow (Kelly 1988 and ADNR 1999).

In winter and spring, the ringed seal frequents land-fast ice and offshore pack ice; the highest densities of seals are usually found on stable land-fast ice. In areas with limited shore-fast ice but wide expanses of pack ice, such as the Beaufort Sea, Chukchi Sea, and Baffin Bay, the number of ringed seals on pack ice may exceed that on shore-fast ice (Burns 1970, Stirling et al. 1982, and Finley et al. 1983).

Mating occurs in late April and May, primarily on land-fast ice. Females give birth to a single, white-coated pup in snow-dens on either land fast or drifting pack ice during late March or early April, and are nursed for 4 to 6 weeks. Quantitative surveys of ringed seals conducted during late winter and spring found ringed seal densities on the shore-fast ice between Oliktok Point and Flaxman Island ranging from 2.5 seals/mi^2 (0.97 seals/km^2) to 4.4 seals /mi^2 (1.69 seals/km^2) during the 1985-1987 period (Frost and Lowry 1988). BPXA-sponsored aerial surveys for ringed seals conducted around Liberty Island as well as in fast-ice areas north of the barrier islands in May to June 1997 found densities ranging from 1 seal/mi^2 (0.43 seals/km^2) (maximum survey density) to 1.2 seals/mi^2 (0.48 seals/km^2) (maximum daily density). North of the barrier islands, ringed seal densities were slightly higher, ranging from 1.3 to 1.5 seals/mi^2 (0.51 to 0.58 seals/km^2) (Miller et al. 1998).

Ringed seals are sensitive to underwater sounds in the 1 to 60 kHz band (Terhune and Ronald, 1975). Underwater audiograms have been obtained using behavioral methods for three species of phocid seals, including the ringed seal (reviewed in Richardson et al. 1995a). Below 30-50 kHz, the hearing threshold is essentially flat down to at least 1 kHz. There are few published data below 1 kHz, but a harbor seal's threshold deteriorated gradually to 97 dB 100 Hz (Kastak and Schusterman 1995). If this also applies to ringed seals, they have considerably better hearing sensitivity at low frequencies than do small odontocetes such as beluga whales (for which the threshold at 100 Hz is about 125 dB). No data are available on their reactions to underwater sounds due to the difficulty of observing these animals in water (USACE 1999).

Ringed seals produce clicks with fundamental frequency of 4 kHz and varying harmonics up to 16 kHz (Schevill et al. 1963). Stirling (1973) described barks, high pitched yelps, and low and high pitched growls. Ringed seals appear much less vocal in summer than during the breeding season in spring (Stirling et al. 1983).

The ringed seals molt in May and June. During this time they spend long periods hauled out on the ice basking in the sun. It is thought that warmer skin temperatures cause rapid hair growth. When hauled out on the ice, ringed seals are wary of predators. The amount of time spent on the ice increases as the molt season progresses. In summer, as the nearshore ice melts, most of the adult ringed seals are found along the edge of the ice pack, seaward of the proposed development area. Ringed seals spend much of the summer and early fall in the water feeding. They eat a variety of invertebrates and fish. The particular species eaten depends on availability, depth of water, and distance from shore. In Alaskan waters, the important food species are Arctic cod, saffron cod, shrimp, and other crustaceans (ADNR 1999). In the eastern Beaufort Sea and Amundsen Gulf, ringed seals concentrate in offshore areas, often in large groups. The groupings appear to be associated with simultaneous populations of various prey species, such as crab and shrimp. Ringed seals offshore of the proposed pipeline ROW are likely to be individuals or small groups during the summer, as larger groups have not been reported during the summer in the central or western Beaufort Sea (LGL et al. 1998).

3.8 TERRESTRIAL MAMMALS

Mammals, especially large mammals and arctic foxes, have been the subject of extensive research in the region of the North Slope oilfields in the last 3 decades. These studies have provided important information for the region as a whole, but only a few have directly addressed terrestrial mammal populations in the proposed Point Thomson Gas Cycling project area. Field investigations of terrestrial mammals in the Point Thomson study area have focused primarily on aerial surveys of caribou (*Rangifer tarandus)*. Observations of muskoxen (*Ovibus moschatus*), moose (*Alces alces*), and grizzly bears (*Ursus arctos*) were documented incidentally during those surveys and other fieldwork. The earliest large mammal surveys that included portions of the Point Thomson study area were conducted in the mid- to late 1970s (described in WCC and ABR 1983). More systematic surveys covering some or all of the Point Thomson study area were conducted in 1983 (WCC and ABR 1983, Lawhead and Curatolo 1984), 1984 (Curatolo and Reges 1984), 1987–1990 (Lawhead and Cameron 1988, Smith and Cameron 1992), and 1993–2000 (Pollard 1994, Pollard and Noel 1995, Noel 1998, Noel and Olson 1999a, Noel and King 2000). In addition, the Alaska Department of Fish and Game (ADF&G) conducted surveys of grizzly bears in the Point Thomson study area in 1997 and 1999 (Shideler 1999), and recorded incidental observations in 1998. Surveys of arctic fox (*Alopex lagopus*) dens were conducted in the Point Thomson study area in

1983 (WCC and ABR 1983), 1992 (Burgess et al. 1993), and 1999 (Perham 2000). Table3-6 lists the terrestrial mammal species expected to occur within the proposed development area and the seasonal time frame in which they are most likely to be present.

3.8.1 Caribou

The Alaska Department of Fish and Game (ADF&G) manages caribou (Inupiaq name Tuttu) and follows Skoog (1968) in identifying herds based on their fidelity to calving grounds. Based on this criterion, four herds are recognized in Arctic Alaska (moving from west to east): the Western Arctic Herd (WAH), the Teshekpuk Lake Herd (TLH), the Central Arctic Herd (CAH), and the Porcupine Herd (PCH). Caribou from both the CAH and the PCH potentially use the Point Thomson study area.

The CAH ranges from the Colville and Itkillik rivers on the west to the Canning and Tamayariak rivers on the east (Figure 3-4). Telemetry studies have shown that about half of the CAH (called the eastern segment) tends to spend the calving and insect seasons east of the Sagavanirktok River. The other half of the CAH (western segment) ranges on the west side of the Sagavanirktok River, including the area occupied by the Prudhoe Bay and Kuparuk oilfields and associated satellite developments (Lawhead 1988, Cameron et al. 1995). The two segments of the CAH are not isolated from each other; some interchange occurs between segments, primarily among years rather than within years (Lawhead and Curatolo 1984).

The CAH increased steadily from about 4,000–6,000 animals in the mid-1970s, when it was first described by ADF&G as a distinct herd (Cameron and Whitten 1979), to a peak of about 23,400 in July 1992 (Woolington 1995) before declining. Between 1992 and 1995, the CAH declined 23%, to about 18,100 caribou (James 1996). The herd subsequently increased to about 19,700 caribou by July 1997 and about 27,100 caribou by July 2000 (E. Lenart, ADFG, pers. comm.), the largest size since it was first described. Figure 3-5 shows the change in size of the CAH since 1972. Hunting mortality of CAH caribou is relatively light, estimated at 200–600 animals annually in recent years (Woolington 1995). It consists mostly of subsistence harvest by villagers from Nuiqsut and, to a lesser extent, Kaktovik, as well as sport harvest along the Dalton Highway. The western segment of the herd regularly encounters oil-field infrastructure (e.g., drill-site pads, roads, pipelines, processing facilities) and industrial activity on its summer range. The eastern segment likely encounters the Badami pipeline each summer.

Table 3-6 Terrestrial Mammals Known or Suspected to Occur in the Point Thomson Area

COMMON NAME	SCIENTIFIC NAME	STATUS
Barrenground Shrew	*Sorex ugyunak*	√
Tundra Shrew	*Sorex tundrensis*	√
Snowshoe Hare[a]	*Lepus americanus*	*
Tundra Hare[a]	*Lepus othus*	*
Arctic Ground Squirrel	*Spermophilus parryii*	√
Northern Red-Backed Vole[a]	*Clethrionomys rutilus*	*
Tundra Vole	*Microtus oeconomus*	√
Singing Vole	*Microtus miurus*	√
Brown Lemming[b]	*Lemmus trimucronatus*[b]	√
Collared Lemming[c]	*Dicrostonyx groenlandicus*[c]	√
Porcupine[a]	*Erethizon dorsatum*	*
Coyote[a]	*Canis latrans*	*
Gray Wolf	*Canis lupus*	√
Arctic Fox	*Alopex lagopus*	√
Red Fox	*Vulpes vulpes*	√
Brown Bear	*Ursus arctos*	√
Ermine, Short-Tailed Weasel	*Mustela erminea*	√
Least Weasel	*Mustela nivalis*	√
Mink[a]	*Mustela vison*	*
Wolverine	*Gulo gulo*	√
River Otter[a]	*Lontra canadensis*	*
Lynx[a]	*Lynx canadensis*	*
Moose	*Alces alces*	√
Caribou	*Rangifer tarandus*	√
Muskox	*Ovibos moschatus*	√

Except where noted, names are from Wilson and Reeder (1993). √ indicates species is documented or very likely in the study area. * indicates species, if present, is rare and at the limits of its range.

[a] These species, although they may occur in some areas of the Arctic Coastal Plain, are unlikely to occur in the Point Thomson study area due to its distance from major riparian corridors.
[b] Name from Chernyavsky et al. (1993)
[c] Name from Jarrell & Fredga 1993

The range of the PCH on the ACP extends east from the western edge of ANWR (the eastern edge of the Point Thomson study area) in northeastern Alaska and into the north-central Yukon and western Northwest Territories in Canada (Figure 3-4). This herd typically calves on the coastal plain and northern foothills of the Brooks Range in ANWR and the Yukon Territory. After increasing about 5% annually during 1976–1989, the PCH decreased 10% from 178,000 in 1989 to 160,000 in 1992 (Whitten 1995). The population was thought to have stabilized at ~160,000 animals after 1992 (K. R. Whitten, pers. comm.), but declined to ~129,000 by 1998 (Stephenson 1999). Throughout its range, the PCH is an important subsistence resource for Inupiat, Inuvialuit, and Gwich'n villages in both northeastern Alaska and northern Yukon, although hunting mortality

is considered to be relatively light (1–3% of the herd); the estimated annual harvest has ranged from 1,600 to 4,800 animals in recent years (Stephenson 1999). PCH caribou have no exposure to industrial activity on summer range, although some cross road corridors such as the Dempster Highway in the Yukon during spring and fall migrations.
The annual cycle of CAH and PCH caribou has been subdivided into different phases for descriptive purposes by various authors (Roby 1978, Russell et al. 1993). The greatest use of the Point Thomson study area by caribou occurs in summer, from the calving period (late May–mid-June) through the insect harassment season (late June–August).

3.8.1.1 Calving Season

Most CAH caribou occur on the northern coastal plain during the calving and insect seasons (Lawhead and Curatolo 1984). By May, pregnant cows move north and disperse widely over the coastal plain to calve in late May–early June. Each cow bears one calf. In most years, calving by the CAH is concentrated in two general areas: one west of the Sagavanirktok River, in the vicinity of the Kuparuk oilfield, and the other east of the Sagavanirktok River, south of Bullen Point (Whitten and Cameron 1985; Lawhead and Cameron 1988; Murphy and Lawhead 2000). The Bullen Point calving area is potentially within the proposed export pipeline ROW. A substantial amount of effort has been invested in aerial surveys of caribou distribution and abundance in the Bullen–Staines calving concentration area, which was used by the CAH from the late 1970s to mid-1980s (Whitten and Cameron 1985), and which includes the Point Thomson study area. Besides partial coverage annually by ADF&G from the late 1970s to the early 1990s, calving surveys were done in 1983 (WCC and ABR 1983, Lawhead and Curatolo 1984), 1984 (Curatolo and Reges 1984), 1987–1990 (Lawhead and Cameron 1988, Smith and Cameron 1992) and 1993 and 1997–2000 (Noel 1998, Noel and Olson 1999a, Noel and King 2000a). Wolfe (2000) conducted a retrospective Geographical Information System (GIS) analysis of calving habitat selection based on ADF&G radio telemetry from 1980 to 1995.

Calving surveys since the late 1970s show that the Bullen–Staines concentration area was most heavily used for calving before the mid-1980s, in terms of the proportion of the CAH using the area. The area of most concentrated calving activity identified by Wolfe (2000) encompassed the Point Thomson study area in 1980–1982, then shifted inland and to the west during 1983–1989, before shifting back toward the coast west of Bullen Point in 1990–1992 and back inland again in 1993–1995. Recent surveys corroborate the shift of most concentrated calving activity to the southwest of the proposed Point Thomson facilities.

Calving surveys for PCH caribou have been conducted annually since the mid-1970s. Most of the calving data analyses, based on telemetry using standard and satellite collars, have been summarized by USFWS researchers in a series of publications (e.g., Clough et al. 1987, Russell et al. 1993). Extensive telemetry data demonstrate that very little calving activity by the PCH occurs in the western portion of ANWR coastal plain in the Point Thomson study area (Russell et al. 1993). The dearth of PCH caribou calving in that area indicates that the caribou calving in the Point Thomson study area belong to the eastern segment of the CAH. Lawhead and Curatolo (1984) found some radio-collared CAH animals east of the Canning River on a few occasions during the calving season.

3.8.1.2 Insect Season

Following calving, CAH caribou generally stay within 20 mi (32 km) of the Beaufort Sea coast through the insect season (Lawhead and Curatolo 1984).

Telemetry studies show that CAH caribou make extensive east–west movements through the Point Thomson study area in the insect season (Lawhead and Curatolo 1984). These movements account for the large range of variation in distribution and abundance (e.g., 3–5730 caribou in 1993, 1–2714 in 1998, 0–2500 caribou in 1999) documented on periodic surveys during the insect season (Noel and Olson 1999a, Noel and King 2000a). Under mosquito harassment, caribou aggregate and move to the coast to seek relief. Under continuing harassment, they then may move along the coast in large numbers. These coastal aggregations can range from a few hundred to several thousand caribou along the entire stretch of coast between Badami and the Canning River delta (Figure 3-6), with the areas of specific use depending on the weather and insect conditions in any given year (WCC and ABR 1983, Lawhead and Curatolo 1984, Pollard and Noel 1995, Noel 1998, Noel and Olson 1999a, and Noel and King 2000a). The maximum group size of CAH caribou recorded in the Point Thomson study area during the 1983 insect season was 2600 caribou near Bullen Point in 1983 (WCC and ABR 1983), about 20% of the CAH at that time.

Insect-harassed PCH caribou infrequently move across the Canning River from the east. PCH caribou usually do not remain on the coastal plain during the insect season. The typical pattern is for the largest numbers to approach the Beaufort Sea coast during the post-calving period and beginning of the insect season (Clough et al. 1987, Russell et al. 1993), when mosquitoes predominate. The majority of the herd then moves southeast into the foothills and mountains of the Brooks Range as July progresses. In some years, however, PCH caribou may mix with caribou from the eastern segment of the CAH. In those unusual circumstances, very large numbers of caribou may enter the Point Thomson area. The largest group of caribou documented using the Point Thomson study area was an aggregation of ~20,000 caribou, comprising a mixture of CAH and PCH animals (as confirmed by radio telemetry), that moved west through the study area to within 7 mi (11.3 km) of the Sagavanirktok River Delta during 10–12 July 1988 (Lawhead and Smith 1990). Under mosquito harassment, the aggregation returned eastward into the study area on 13 July 1988 to the vicinity of Point Gordon (Lawhead and Smith 1990). The late 1980s was a period when a substantial amount of mixing of CAH and PCH caribou occurred on the summer range, thwarting attempts to complete a photocensus of the CAH (Woolington 1995).

When temperatures cool and mosquito activity abates, CAH caribou move away from the coast, usually to the south and west. Mosquito harassment declines markedly by late July (Roby 1978, Dau 1986, Lawhead and Curatolo 1984), leaving oestrid flies as the predominant insect pests. By mid-July, oestrid flies drive caribou to seek relief in a variety of unvegetated and elevated sites, such as river bars, mud flats, dunes, pingos, gravel pads, and roads (Roby 1978, Dau 1986). In areas of human activity, relief from flies is often sought in the shade of elevated pipelines, buildings, and even parked vehicles. Fly harassment typically continues into August (Lawhead and Curatolo 1984, Dau 1986), when CAH caribou begin to disperse inland and migrate south off the coastal plain.

3.8.1.3 Migration and Winter

The decline of mosquito activity in late July and early August marks the beginning of a period of inland dispersal. In an intensive telemetry study in 1983, radio-collared CAH caribou that had summered in the Point Thomson area had begun dispersing inland and far to the west by early August, with some crossing the Sagavanirktok River (Lawhead and Curatolo 1984). Although a few caribou breed and winter (October–April) on the outer coastal plain, most of the CAH moves considerably farther south to the foothills and mountains of the Brooks Range during this period (Cameron and Whitten 1979, Carruthers et al. 1987, Murphy and Lawhead 2000). In October 2000, large numbers of CAH caribou were on the south side of the Brooks Range west of Arctic Village (E. Lenart, ADF&G, pers. comm.). No winter survey data of caribou are available for the

Point Thomson study area. In contrast to the CAH, which have relatively limited seasonal migrations, PCH caribou undertake extensive migrations (with some exceeding 3,000 mi/yr (4,828 km/yr)) in moving to and from winter ranges well south of the Brooks Range in the Yukon and eastern Alaska (Fancy et al. 1989, Russell et al. 1993).

3.8.1.4 Summary

In summary, the greatest degree of use of the Point Thomson study area by caribou occurs between late June and August during the insect season, when large aggregations form and move to and along the coast under insect harassment. The highest density of caribou calving in the region currently occurs southwest of the study area from late May to mid-June; although relatively few cows calve in the study area. Most CAH caribou and nearly all PCH caribou breed and winter considerably south of the Point Thomson study area.

3.8.2 Muskoxen

Muskoxen native to the North Slope of Alaska were extinct from the North Slope by the late 1800s (Smith 1989). Muskoxen were reintroduced on the Arctic Coastal Plain at Barter Island (in ANWR) in 1969 and at the Kavik River (between Prudhoe Bay and ANWR) in 1970 from Nunivak Island in western Alaska. The reintroduced population expanded west and east within a decade (Garner and Reynolds 1986). The ANWR population stabilized at 350 to 400 muskoxen after 1986, whereas numbers to the west continued to increase (Reynolds 1992a, 1995). Stephenson (1993) estimated that 165 muskoxen inhabited the region between the Colville River and ANWR, out of a total population exceeding 550 animals in northeastern Alaska and the northern Yukon.

Muskoxen move in response to seasonal changes in snow cover and vegetation but most activities occur in riparian habitats associated with the major river drainages on the coastal plain. During the winter, muskoxen use upland habitats near ridges and bluffs where shallow snow cover allows easy access to forage plants (Klein et al. 1993). During spring, muskoxen use moist tussock tundra and moist shrub tundra habitats, which provide high quality flowering sedges (Jingfors 1980; Reynolds et al. 1986). By summer most muskoxen are found on river terraces, gravel bars, and shrub stands along rivers and tundra streams where forage includes willow leaves, forbs and sedges (Jingfors 1980; Robus 1981, 1984; O'Brien 1988). Muskoxen calving areas are poorly known, but the majority of the population appears to calve in the southern portion of the coastal plain on wind-blown, snow-free banks along rivers, and in upland foothill sites. Muskoxen groups typically include 10–30 animals and numbers decrease in summer as the breeding season (rut) [Aug.–Sep.] approaches (Reynolds et al. 1986; Reynolds 1992a). Bull muskoxen may move between mixed-sex groups during the summer and form bull groups during the winter. Calving occurs from late April to late June, peaking in mid-May (Reynolds et al. 1986). Cows produce single calves at intervals of one to three years. Few muskoxen calve within the project area and it is probable that most calving occurs at inland sites south of the project area (P. Reynolds USFWS, ANWR, pers. comm.).

Aerial surveys of muskoxen adjacent to the proposed project area were conducted in 1983 (WCC and ABR 1983), from June through September 1993–1995, and 1997–2000 (Pollard 1994, Pollard and Noel 1995, Noel 1998, Noel and Olson 1999a, Noel and King 1999a) (Figure 3-7). No muskoxen were observed in the Point Thomson study area during surveys in 1983 (all muskoxen observations were east of the Staines River) or 1997. However, several animals were observed on Flaxman Island during the summer of 1997 (pers. communication B. Trimm). During other years, the majority of animals observed during surveys were in small mixed-sex groups moving up and down the major rivers in the area. The largest number of muskoxen in the Point Thomson study area was 32 (4 groups) observed during 1999 (Noel and King 2000).

3.8.3 Grizzly Bear

Grizzly bears (Inupiaq name Aglaq) occur throughout northern Alaska from the Brooks Range northward to the ACP. The ADF&G manage grizzly bears by controling hunting seasons and bag limits. Conservative management practices have been implemented since the 1960s, when a statewide decline in bear numbers resulted primarily from aircraft-supported hunting associated with guiding (Hicks 1999). The Point Thomson study area is located in Game Management Unit (GMU) 26B (near 26C) where the long-term trend in grizzly bear population is thought to be stable at about 262 bears (1.7 bears/100 km^2 [1.7 bears/62 mi^2]); Hicks 1999). Densities are highest in the foothills of the Brooks Range and lowest on the ACP. However, artificial food sources are powerful attractants for grizzly bears and often have resulted in increased density and productivity of bears, including in the Prudhoe Bay oil fields (Shideler and Hechtel 2000). Grizzlies in the Prudhoe Bay and Kuparuk oil fields have larger litters, higher growth rates, and greater body sizes than bears elsewhere on the ACP (Shideler and Hechtel 1993, 1995a, 2000).

Since the 1989-90 hunting season, annual grizzly bear harvest in GMU 26B has ranged between 11 (1995-96) and 26 (1996–97 and 1997–98) (Hicks 1999). The management objective of the ADF&G in GMU 26B is to maintain a population capable of sustaining an annual harvest of 13 bears, with at least 60% males in the harvest. Since 1985, about one-half of the reported bear harvest in GMU 26B was by nonlocal residents and the other half by nonresidents (only one hunter of 176 total during that period was listed as a local resident of GMU 26B) (Hicks 1999). Unreported take by local hunters is unknown, but likely (Hicks 1999). Hunting pressure is higher in GMU 26B than other North Slope units because of the increased access allowed by the Dalton highway. Harvest of grizzly bears in GMU 26B is closely monitored and was subject to emergency closure in 1998 after harvest objectives were exceeded in 1996-97 and 1997-98.

Grizzlies use river drainages on the ACP as primary travel routes and foraging areas (Shideler and Hechtel 1995a; Johnson et al. 1996, 1997). Grizzly bears have large home ranges (1000-2000 mi^2 [1600-3200 km^2]) and may move 30 or more mi (49 km) in one day (Shideler and Hechtel 1995a). Bears move north from denning areas in the foothills in late May, and are most abundant on the coastal plain during June and July when caribou also are present. In late July, after caribou have left, bears gradually return to the foothills (Clough et al. 1987).

Riverine habitats contain preferred foods, such as legumes (flowering plants in the pea family) and ground squirrels. Bears also feed on sedges and other graminoids, root plants, berries, eggs, fox pups, and microtine rodents (Quimby 1974; Garner and Reynolds 1986; Garner et al. 1986). Frequently used habitats include forb-rich river bars (which contain root plants, bearberry, and ground squirrels), dry shrub tundra along river terraces (with ground squirrels and bearberry), and both coastal and river-delta dunes (having abundant ground squirrels). Within the proposed Point Thomson project area, most grizzly bear foraging habitat is concentrated in riparian areas to the east or west or along the coast. ADF&G suggested that use of the Point Thomson project areas by grizzly bears would comprise mainly movements between preferred riparian areas to the east and west or attraction of bears to carcasses or seaweed along the coast (Shideler 1999).

Grizzly bears in northern Alaska den from early October to late April or early May. One to three cubs (average of two) are born per litter in December or January (Reynolds 1979, Garner and Reynolds 1986, Shideler and Hechtel 1995a). Males and females remain separate for most of the year, coming together only briefly to court and mate between May and July (Garner et al. 1986). Grizzlies dig dens in pingos, banks of rivers and lakes, dunes, and steep gullies in uplands on the coastal plain (Harding 1976; Shideler and Hechtel 1995b; Shideler, ADF&G, pers. comm.). Most of the bears studied by ADF&G in the Prudhoe Bay oil fields denned within 30 mi (48 km) of the oilfields, although a few denned 60 to 100 mi inland (Shideler and Hechtel 1995b; Shideler, ADF&G, pers. comm.). Figure 3-8 shows surveyed grizzly bear dens located in the region. No collared bears have denned in the Point Thomson study area (Shideler 1999).

Little information exists about grizzly bear use of the proposed Point Thomson project area before 1991. However, unconfirmed reports from Bullen Point Distant Early Warning (DEW) station personnel in the 1970s, and the reported harvest of two bears in 1969 from sites along the Kadleroshilik River (ADF&G files) provide some evidence of grizzly bear presence in the region. Figure 3-9 shows locations of grizzly bear sightings over the period 1991 through 1994. In addition, since 1997, ADF&G has reported nine separate observations of bears (two of these females with single cubs) in the Point Thomson study area (Shideler 1999). Other incidental observations include three bears, each about 15 mi (24 km) inland in 1997 (Noel 1998), two bears 8 mi (13 km) south of Bullen Point in 1998 (Noel and Olson 1999a), and two observations of the same bear near the southwestern edge of the study area in 1999 (Noel and King 2000a). In addition, bird survey crews observed several grizzly bears near Point Thomson Unit #3 in the summer of 2001 (pers. communication D. Trudgeon). Grizzly bears have been sighted somewhat more frequently in the adjacent Badami development area, where riparian habitats occur on the Kadleroshilik and Shaviovik rivers (LGL 1993, Pollard 1994, Pollard and Noel 1995, and Noel and Olson 1999b).

3.8.4 Arctic Fox

Arctic foxes (Inupiaq name Pisukkaaq) occur across the ACP including the Point Thomson area. Great temporal fluctuations in populations of arctic foxes are well known from fur harvest data in North America and Russia. On the North Slope, as in other regions, the population cycle (based on fur harvest data) is believed to be 3 to 4 years, fluctuating in response to lemming population cycles (Burgess 2000). However, actual population estimates are difficult to obtain and generally lacking. Arctic foxes are readily attracted to areas of human activity and to artificial food sources, such as dumpsters or open pit garbage dumps (Eberhardt et al. 1982, Burgess et al. 1993, and Burgess 2000). When not harassed, arctic foxes show little natural fear of humans and human structures provide readily used shelter for arctic foxes in all seasons, including use as dens during the breeding season. Development activities in the Prudhoe Bay oil fields have led to increases in fox numbers and productivity (Eberhardt et al. 1983, Burgess et al. 1993, Rodrigues et al. 1994, Burgess 2000, and Ballard et al. 2000a). The average density of dens is three to five times higher in developed portions of the oil fields than in undeveloped areas of the coastal plain (Garrott 1980, Eberhardt et al. 1983, Burgess et al. 1993, Johnson et al. 1999a, and Burgess 2000). In addition, both the rate of den occupancy and litter sizes are substantially higher in the oil field than in adjacent undeveloped areas (Eberhardt et al. 1983, Burgess et al. 1993, and Rodrigues et al. 1994). These effects have been attributed to the availability of garbage as a food source, especially during winter. Fox extirpation efforts have been undertaken periodically to remove foxes from the oil field when there was a perceived overabundance of foxes (Burgess 2000 and Ballard et al. 2000b). The main concern is that overabundance of arctic foxes, especially those that are habituated to humans, increase the risk to humans of rabies and hydatid disease. An additional concern regarding the higher densities and reduced population fluctuations of fox populations in the oil fields is the potential impact on nesting shorebirds and waterfowl (Burgess 2000).

Arctic foxes are opportunistic predators and scavengers and their movements reflect their ability to exploit locally, seasonally, or artificially abundant food sources. In times of food scarcity, arctic foxes may move long distances in distinct seasonal patterns between dispersed summer breeding territories on the tundra and winter habitats along the coast or on the sea ice (Chesemore 1975 and Clough et al. 1987). Those on the sea ice move back onshore in late winter or early spring and again establish breeding territories (Chesemore 1975). Remarkable long-distance movements by individual arctic foxes have been documented, including movements of 80 to 1,400 mi (129 to 2,253 km) by eight arctic foxes marked and released near Prudhoe Bay (Eberhardt and Hanson 1978 and Burgess, unpub. data). In contrast, when food is locally abundant, arctic foxes may remain resident near their natal dens year around. During summer, territorial aggression between mated pairs tends to disperse foxes on the tundra (Eberhardt et al. 1983 and Burgess 1984). During fall, arctic foxes gradually abandon territorial den defense and, depending on food availability may simply increase their home range sizes or disperse widely. During winter, arctic foxes are less territorially aggressive and usually nonsocial, although they may congregate and interact in areas where food is abundant. Dense aggregations of arctic foxes may occur where food is superabundant during winter, e.g., at marine mammal carcasses and garbage dumps.

Small mammals (mainly collared and brown lemmings but also singing and tundra voles and ground squirrels) are the most important prey of arctic foxes, supplemented by caribou and marine mammal carcasses and, in summer, by nesting birds and their eggs (Chesemore 1968, Garrott et al. 1983, and Burgess 1984). During summers when lemmings are scarce, arctic foxes typically rely on the eggs of ground-nesting birds, sometimes devastating local egg production. When lemmings are scarce during other seasons (i.e., when birds are absent), arctic foxes eat mainly carrion, often on the coast or sea ice, and in late winter they may prey on seal pups in lairs (Smith 1976). When food is abundant during summer, arctic foxes cache many food items; an adaptation to regulate the wide seasonal and annual fluctuations in food abundance that occur in high-latitude environments. In villages, construction camps, and developed oil fields, garbage, and handouts may become important food sources (Urquhart 1973, Eberhardt 1977, Eberhardt et al. 1982, Fine 1980, Burgess et al. 1993, Rodrigues et al. 1994, and Burgess 2000).

Arctic foxes forage in a wide variety of habitats, but they exhibit strong habitat preferences for denning (Johnson et al. 1996 and 1997) and their dens are more or less permanent and widely recognized components of the coastal plain landscape. Preferred sites include pingos, small mounds, low hills, and ridges 3 to 13 ft (1 to 4 m) high – sites that are chosen for their thin snow accumulations, elevations above water tables, deep active (thaw) layers, surface stability, and sandy soils (see Burgess 2000 for review). These typical dens generally are stable structures that persist for decades (Macpherson 1969), and older dens, which are strongly preferred by arctic foxes, are large, conspicuous structures, often with >50 burrow entrances and strongly modified vegetation. However, many dens on the coastal plain are less conspicuous than the large "typical" dens, and these may be newly developing dens or "temporary" dens that are not likely to be used in subsequent seasons (Burgess 2000). Arctic foxes may use the same den site in successive years and, although populations fluctuate widely between years, in general, more dens are available each year than are used. Arctic foxes living in the oilfields have also been reported to den in artificial structures, such as utility corridors, culverts, abandoned vehicles or heavy equipment, and crawl spaces (Burgess 2000) and to use both natural and artificial dens for winter shelter (Eberhardt et al. 1983). Despite strong denning-habitat preferences, the scarcity of "typical" den sites is not likely to limit the abundance of arctic foxes in any area (Macpherson 1969 and Burgess 2000). Arctic foxes are capable of denning in a wide variety of sites and most tundra landscapes on the coastal plain have an abundance of unused dry mounds, vegetated dunes, and low ridges that are suitable for den sites.

The breeding cycle of arctic foxes begins in late winter to early spring, when foxes adopt breeding territories, mate (March-April), and den. Pups are born between May and early July after a seven to eight week gestation. Litter sizes can be remarkably large in arctic foxes and show considerable annual and regional variability. The most comprehensive evaluation reported that litters averaged 10.6 pups at birth and 6.7 pups at weaning (Macpherson 1969). In the Prudhoe Bay region in 1992, the mean litter size in late summer was 4.6 and the largest litters had 13 pups (Burgess et al. 1993). In years of lemming scarcity, the only foxes with litters that survived to late summer were those living near oil-field facilities.

Because most arctic fox den sites have a history of repeated used and because arctic foxes appear to prefer such sites for breeding, den locations can be mapped and censused annually to obtain an index to local arctic fox abundance and productivity. Four separate investigators have surveyed all or portions of the Point Thomson study area for arctic fox dens: Quimby and Snarski (1974), WCC and ABR (1983), Burgess and Banyas (1993), and Perham (2000). Only Perham (2000) conducted systematic surveys of the entire Point Thomson study area (as currently defined). A few arctic fox dens have been located in the Point Thomson study area to date (Figure 3-10).

The small number of dens in the Point Thomson study area could be attributed to the lack of relief in the area (i.e., few elevated mounds or pingos) and to inadequate survey conditions (Perham 2000). The Point Thomson study area lies on an alluvial fan of the Canning River, with sand and gravel soils, lack of relief, and lack of riparian habitats (streambanks and river bluffs that also provide relief). These geomorphological factors may not be favorable to the development of "typical" arctic fox dens; i.e., sites with a long history of use and strongly modified vegetation, making them easy to locate during late summer surveys. For this reason, early spring surveys (in which arctic fox dens are located by arctic fox tracks and evidence of recent excavation in a snow-covered landscape) may be more successful at locating arctic fox dens in the Point Thomson study area. However, according to Perham (2000) snow cover was not optimal during the spring surveys conducted in 1999, and even the two dens that were later documented to be active in 1999 (Dens 203 and 204) were not located during that survey (see discussion in Perham 2000).

3.8.5 Moose

Moose are distributed across the North Slope in low numbers, concentrating in all seasons in narrow strips of shrub communities along major river drainages (Mould 1977 and Hicks 1998). Moose on the North Slope are at the limit of their range and are susceptible to nutritional stress and starvation during bad winters (Hicks 1998). Moose populations on the North Slope have fluctuated widely from very low numbers, mainly in the Colville River, in the 1940s, to an estimated 1600 moose in the 1980s. The Point Thomson study area is on the eastern edge of GMU 26B. ADF&G has conducted early winter composition counts in GMU 26B almost annually since 1986 (ADF&G 1996 and 1998). Before 1992, the population was thought to include 1000 to 1200 moose in GMU 26B. In the 1990s, North Slope moose populations experienced a rapid decline; in GMU 26B there was a 75% decline between the late 1980s and 1994, and populations remained at low levels through 2000. Figure 3-7 includes moose sightings recorded in 1994. Calf survival and recruitment have remained extremely low through the 1990s. The causes of population decline on the North Slope remain unknown but predation, insect harassment, and range deterioration all may have contributed. The precipitous decline in numbers led to total closure to moose hunting in GMU 26B (and other North Slope GMUs) in 1996.

Kaktovik and Nuiqsut are the only subsistence communities in the eastern North Slope GMUs 26B and 26C), and residents took 5-10 moose annually prior to season closure (note that Nuiqsut residents hunt mainly in the Colville River drainage, which lies in GMU 26A) (Hicks 1998). Although travel to the area is expensive and logistically difficult, the impacts of sport hunting were considerable prior to closure, particularly near better known aircraft landing sites. The reported moose harvest in Unit 26B ranged from 24 to 52 during 1986-1995 (Hicks 1996). Harvests declined during the early 1990s, apparently due to the decreases in moose numbers that lead to total closure. The concentrated nature of moose distribution and the open habitat create a potential for excessive harvest in accessible areas.

During all seasons, moose activity on the North Slope of the Brooks Range is concentrated in riparian habitats of major rivers. In winter, riparian areas are especially important, as forage is available only in willow stands that are not covered by drifting snow (Mould 1977). Following snow-melt in May, moose may be somewhat more dispersed across the tundra, as casual observations suggest occasional movements between river drainages in snow-free seasons. In the 1002 area of ANWR (east of the Point Thomson study area), moose concentrated in the foothills of the Brooks Range during winter and moved northward along river drainages (including the Canning River) in late spring-early summer (Clough et al. 1987).

Moose calve during mid-May to early June and rut during late September and early October. Gestation is about 243 days. Females typically breed annually and give birth to a single calf, although twins are not uncommon when nutrition is good.

Among all large mammal surveys in the Point Thomson study area conducted during 1993, 1994, 1995, 1997-2000, only four bull moose were sighted during three surveys in 1994 (Figure 3-7) (Pollard 1994, Pollard and Noel 1995, Noel 1998, Noel and Olson 1999a, and Noel and King 2000).

3.8.6 Other Mammals

Wolves (*Canis lupis*) (Inupiaq name Amaruq) occur in low densities on the ACP and are more common in the mountains and foothills. The North Slope population has remained low since federal predator control in the 1950s and 1960s, but reports of local trappers in Nuiqsut suggest that the population may be increasing in recent years (G. Carroll, NSB, pers. comm.). Other canids that may occur in low numbers in the Point Thomson study area include coyotes and red foxes. Both are associated primarily with higher productivity riparian habitats on the North Slope and, therefore, probably rarely occur in the Point Thomson study area.

Wolverines (*Gulo gulo*) (Inupiaq name Qavvik) occur in low numbers on the Arctic coastal plain, but are more common in the Brooks Range and the foothills (Bee and Hall 1956). Denning occurs primarily in the mountains and foothills in areas with deep snow cover. Habitats used most frequently by wolverines include tussock tundra meadows, riparian willow and alpine tundra (USDI 1978). Wolverines are predators and scavengers of caribou and are found in association with caribou calving and post-calving areas, suggesting that they may be present during caribou calving in the Point Thomson study area. The arctic ground squirrel (*Spermophilus parryii*) (Inupiaq name Sigzik) is abundant on the Arctic coastal plain, with highest densities along major river drainages (Bee and Hall 1956). Because they live underground, ground squirrels require unfrozen soils that are deep enough for burrowing. Typical habitats are uplands, such as sand dunes, ridges, riverbanks, bluffs and pingos. On the coastal plain, ground squirrels are most abundant along major river drainages. Ground squirrels hibernate from September to May (McLean and Townes 1981 and Garner and Reynolds 1986). Mating occurs immediately after hibernation and young are born in June following a three to four week gestation. Ground squirrels eat mainly plants (at least 40 species have been documented to be consumed) as well as occasional carrion, lemmings and voles, and eggs of ground-nesting birds (Batzli and Sobaski 1980 and McLean 1985). Squirrels are an important prey species for golden eagles, foxes, and grizzly bears (Garner and Reynolds 1986).

Lemmings are the most common small mammals on the ACP and their numbers fluctuate dramatically in a 3-4 year cycle in most areas. Collared lemmings (*Dicrostonyx torquatus*) prefer drier habitats found in tussock tundra and high center polygons, while brown lemmings *(Lemmus sibiricus*) inhabit wet sedge meadows and polygonized areas. Collared lemmings eat mostly shrubs (willows and *Dryas*) and forbs, while brown lemmings and tundra voles eat sedges and grasses (Pitelka 1957 and Batzli et al. 1983).

The ermine (or short-tailed weasel) (Inupiaq name Itiriaq) and least weasel (Inupiaq name Naulayuq) are relatively common predators of small mammals on the ACP. Little is known of their population sizes or densities, but they are important predators of lemmings and may play a role in population cycles of those species (MacLean et al. 1974). Other mustelids that may occur in low numbers include mink and river otter, both of which are highly associated with major rivers and, therefore, probably very rarely occur in the Point Thomson study area.

Other small mammals likely to be found in the Point Thomson study area include tundra voles, and barren ground and tundra shrews. Tundra voles are less common than lemmings and are patchily distributed on the Arctic coastal plain. Little is known of the abundance or distribution of shrews on the Arctic coastal plain, although they appear to be widely distributed.

3.9 THREATENED AND ENDANGERED SPECIES

The Point Thomson project area is seasonally occupied by the spectacled eider, which has been identified as threatened under the Endangered Species Act (ESA). Spectacled eider populations have declined by more than 96 % from historical levels (50,000 pairs) on the Yukon–Kuskokwim Delta in western Alaska (Stehn et al. 1993). Historical records of spectacled eider abundance on the ACP are unavailable, but the USFWS has estimated the current population to be at least 5,000 to 7,000 breeding birds (Larned et al. 2001). Recent estimates suggest that the ACP now supports the main breeding population of spectacled eiders in Alaska (USFWS 1994 and Larned et al. 1999). Spectacled eiders also nest on the Yukon–Kuskokwim Delta, possibly on the Seward Peninsula, and in arctic Russia. Data for the nesting population in the Prudhoe Bay area suggest that it may have declined by as much as 80% between 1981 and 1992 (Warnock and Troy 1992 and TERA 1993). However, recent estimates for the breeding population across the entire ACP, based on aerial survey counts since 1992, suggest that the spectacled eider population is relatively stable (Larned et al. 2001).

Aerial surveys for spectacled eiders were conducted in the Point Thomson region in 1994 (Byrne et al. 1994) and during 1998–2000 (TERA 1999, TERA 2000, and D. Troy, TERA pers. comm.), and this area has been encompassed by surveys conducted across the entire ACP by USFWS since 1992 (Larned et al. 1999 and 2001). Surveys of breeding pairs of spectacled eiders in the Point Thomson region have not been conducted for a sufficient time period to identify discernable trends, but densities in the region are lower than those found in other areas in and adjacent to the oil fields (Table 3-7). Most of the spectacled eiders seen during the aerial surveys were in the vicinity of the Kadleroshilik and Shaviovik rivers to the west of the proposed export pipeline tie-in at Badami, and few eiders were seen east of the Shaviovik River (Figure 3-11). No nests of spectacled eiders have been found in the Point Thomson area, although breeding in the area was confirmed by the observation of one brood (female with 4 young) south of Point Sweeny in July 1998 (LGL et al. 1999). Day et al. (1995) observed one pair of spectacled eiders and one male flying west along the coast at the Bullen Point Dewline site during a ground survey of that site in 1994. They also found one badly decomposed carcass of a female-plumaged spectacled eider. No spectacled eiders were seen at the Bullen Point Dewline site during an aerial survey there in June 2000 (Day and Rose 2000). In general, Point Thomson is thought to be located at the eastern range of this species.

Table 3-7 Abundance and Density (birds/mi^2) of Eiders in the Point Thomson Study Area, 1993, 1998–2000.

SPECIES / YEAR	BREEDING PAIRS[A] NUMBER PAIRS	DENSITY PAIRS/MI^2	SURVEY AREA (MI^2)	SOURCE
Spectacled Eider				
1993				
(Sagavanirktok to Mikkelsen Bay)	50	0.37	136.6	Byrne et al. (1994)
(Mikkelsen Bay to Staines River)	4	0.07	56.5	Byrne et al. (1994)
1998	2	0.03	76.7	TERA (1999)
1999	3	0.04	76.7	TERA (2000)
2000	0	0	76.7	D. Troy (pers. comm.)
King Eider				
1993				
(Sagavanirktok to Mikkelsen Bay)	81	0.59	136.6	Byrne et al. (1994)
(Mikkelsen Bay to Staines River)	32	0.57	56.5	Byrne et al. (1994)
1998	133	1.73	76.7	TERA (2000)
1999	127	1.66	76.7	TERA (2000)
2000			76.7	
Common Eider				
1993				
(Sagavanirktok to Mikkelsen Bay)	1	0.01	136.6	Byrne et al. (1994)
(Mikkelsen Bay to Staines River)	1	0.02	56.5	Byrne et al. (1994)
1998 (inland)b	5	0.25	76.7	TERA (1999)
1998 (including coast)	14	0.18	76.7	TERA (1999)
1999 (inland)	18	0.23	76.7	TERA (2000)
1999 (including coast)	75	0.98	76.7	TERA (2000)
2000 (inland)			76.7	
2000 (including coast)			76.7	

[a] Breeding pairs equals numbers of males seen on the surveys.
[b] Common Eiders seen inland from the coast.

Critical habitat had been proposed for spectacled eiders on the North Slope by USFWS (65 FR 6114), but final rulings on this designation (66 FR 9146) did not delineate specific areas for critical habitat protection in the region. Critical habitat was not designated for the North Slope since habitat, and in particular nesting habitat, is not limiting. However, the proposal did identify elements of critical habitat that that may warrant more scrutiny during oilfield planning. These elements included five specific habitats for the North Slope: all deep water bodies; all water bodies that are part of basin wetland complexes; all permanently flooded wetlands and water bodies containing either *Carex aquatilis*, *Arctophila fulva* (pendant grass), or both; all habitat immediately adjacent to these habitat types; and all marine waters out to 25 mi (40 km) from shore, its associated aquatic flora and fauna in the water column, and the underlying benthic community. Many of these habitats are found in the Point Thomson area and within the peoposed pipeline ROW.

Spectacled eiders arrive on the ACP of northern Alaska in late May (Warnock and Troy 1992, Anderson and Cooper 1994, Johnson 1995, and Johnson et al. 1996 and 1997). Observations during the pre-nesting period suggest that habitats containing open water early in the season are important to spectacled eiders (Anderson and Cooper 1994 and Johnson et al. 1999). Nesting begins in mid-June and eggs start hatching in mid-July; males disperse from the area by late June (Warnock and Troy 1992 and Anderson and Cooper 1994). In recent studies on the Colville River delta, spectacled eiders nested in a variety of habitats, including salt-killed tundra, aquatic sedge with deep polygons, brackish water, and non-patterned wet meadow (Johnson et al. 2000a). Spectacled eiders in the Kuparuk Oilfield nested primarily in non-patterned wet meadows within wetland complexes containing emergent grasses (*Arctophila fulva*) and sedges (*Carex* spp.) (Anderson and Cooper 1994, and Anderson et al. 2000). Spectacled eiders in the Prudhoe Bay Oilfield nested principally in non-patterned wet meadows (Warnock and Troy 1992).

During brood-rearing, from mid-July to when the young fledge in early September (TERA 1995), spectacled eiders use a variety of aquatic habitats on the coastal plain. For example, broods on the Colville River delta were observed in nine different habitats, but most broods were seen in two habitats, salt-killed tundra and deep open water with islands or polygonized margins (Johnson et al. 2000a). Brood-rearing in the Kuparuk, Milne Point, and Prudhoe Bay oilfields primarily occurs in water bodies with margins of emergent grasses and sedges, basin wetland complexes, and occasionally deep open lakes (Warnock and Troy 1992, Troy 1994, Anderson and Cooper 1994, and TERA 1995). These results demonstrate that brood-rearing (and nesting) habitat is strongly associated with aquatic habitats, particularly coastal habitats when available. When young are capable of flight, spectacled eiders depart the ACP usually by mid-September, when freeze-up begins.

3.10 SUBSISTENCE AND TRADITIONAL LAND USE PATTERNS

In general, communities harvest the subsistence resources most available to them, concentrating their efforts along rivers and coastlines and at particularly productive sites (Figures 3-12 to 3-14). Determining when and where a subsistence resource will be harvested is a complex activity due to variations in seasonal distribution, migration, and extended cyclical variation in animal populations. Areas that are infrequently used can be important harvest areas at times (DOI 1998). Figure 3-12 shows known historic and current subsistence harvest areas.

Two broad subsistence-resource niches occur on the North Slope:

- Coastal/marine: harvesting of whales, seals, waterfowl, fish, and other marine species
- Terrestrial/aquatic: harvesting of caribou, fish, moose, grizzly bears, other terrestrial animals, and edible roots and berries

Regardless of which subsistence-resource niche or combination of niche resources communities harvest, bowhead whales, caribou, and fish are the primary resources harvested. Caribou and fish are the resources expected to be encountered along the proposed export pipeline corridor. Subsistence hunting strengthens family and community ties and provides a sense of common heritage and culture in Inupiat society (DOI 1998). Sharing and community cooperation were essential in the past. Cooperative harvesting and sharing of food was the best insurance against starvation, maximizing everyone's chances of survival during times of shortage (ADNR 2001).

Non-edible parts of subsistence resources are used to make many functional and/or artistic items. Hides and pelts are used to make bedding, clothing, slippers, mukluks, hats, dolls and other toys, drums, and masks. Ivory, bone, and antler are carved for knife handles, needle cases, and figurines. Jewelry and decoration for clothing and other item is made from many items, including ivory, antler, and feathers (ADNR 2001).

The relationship between engaging in subsistence activities and earning cash wages differs for each individual. The availability of jobs, community goods and services, and subsistence resources also affects the cash-subsistence relationship. The social costs of not participating in traditional subsistence activities of the village economy may be greater that the cash benefits derived from participation in the labor force. NSB residents earning cash wages participate in subsistence activities during weekends and vacations, and employers are encouraged to allow such employees time off during key seasonal events such as whaling (ADNR 1998).

The Point Thomson area encompasses lands traditionally and presently used for subsistence harvest by residents of Nuiqsut and Kaktovik. Traditional subsistence land use of the Point Thomson area included harvesting of fish, marine mammals, terrestrial mammals, birds, fur-bearing mammals, and plants. In addition, many of the marine mammal, fish, and terrestrial mammal species harvested by Nuiqsut and Kaktovik residents in areas other than Point Thomson migrate through the Point Thomson area.

4.0 ENVIRONMENTAL CONSEQUENCES

Environmental consequences of the proposed action at Point Thomson have the potential to impact the physical, biological and social/cultural resources of the area. The following sections discuss the potential effects of the export pipeline construction, operation, and maintenance their anticipated severity, and ways that they may be mitigated.

4.1 Physical/Chemical Resources

Physical and chemical resources of the Point Thomson area include air, surface hydrology and fresh water quality, and permafrost and soils. Project actions such as the placement and/or removal of gravel, fresh water quality emissions, discharges, and spills of materials to the environment, the removal of water from area ponds, lakes, and streams have the potential to locally impact these resources. Export pipeline activities and the effects they produce are likely to differ among winter or summer construction periods and operations. Therefore, the potential effects on the resources due to export pipeline during different project phases are considered separately. Table 4-1 indicates the potential effects of the export pipeline activities on the physical and chemical resources of the area, and during which project phase the effects are anticipated.

The following paragraphs describe the project actions or mechanisms associated with the proposed export pipeline that have the potential to create an effect on the physical and chemical resources, and the methods used for assessing the potential effect.

Placement of Gravel

Placement of gravel along the proposed export pipeline corridor is expected to be limited to the construction of valve pads if valves are found to be required as discussed in Section 2.2.2.4. Any gravel valve pad, if necessary, is expected to be small in size and therefore should not cause any impacts to the surrounding environment. Gravel pad construction can directly affect the tundra through burial. In addition, gravel placement has the potential to affect soil conditions. Gravel placement also has the potential to cause indirect impacts on air quality due to the generation of dust.

Obstruction of Flow/Circulation

Placement of gravel on the tundra to create valve pads could divert, impede, or otherwise block flow into stream channels or braided wetlands. However, since the size of the potential valve pads is anticipated to be small, no impact to flow or circulation is expected. The placement could also affect sheet flow over the tundra creating dry areas on one side of the structure and pools or wetter areas on the other side.

Emissions/Discharge/Spills

Emissions and discharges are defined as liquid or gaseous materials that are released during construction and operations activities at the Point Thomson facility. These releases will be regulated under water and air permits, and will be required to meet the discharge requirements of the permits. Spills are considered to be out-of-control events and can range from small to large quantities. Effects due to small-scale spills during construction and operations activities will be considered in this section. Impacts from large spills are considered in the project ODPCP Plan.

Freshwater Removal

It will be necessary to remove quantities of freshwater to cap the sea ice road and to build infield onshore roads during the two proposed construction seasons. An effect of water removal could include exacerbation of already low oxygen levels under the ice in certain tundra lakes. This effect and others are discussed in more detail in this section.

Table 4-1 Potential Physical and Chemical Consequences

	PROJECT ACTIONS				
Physical/Chemical Resources	Placement of Gravel	Obstruction of Flow/ Circulation	Emissions/ Discharges or Spills	Water Removal	Gravel Removal
Air Quality	Y (W)[1]	N/A	Y (W,S,O)	N/A	Y (W)[1]
Surface Hydrology	N/A[2]	Y (W,S,O)[3]	N/A	Y (W,S,O)[3]	Y (W)
Freshwater Quality	Y(W,S)[4]	Y(W,S,O)	Y(W,S,O)	Y (W,S,O)[3]	Y (W)
Permafrost and Soils	Y (W,S,O)	N/A	N/A	N/A	Y (W)

[1]generation of dust
[2]impacts considered under obstruction of flow/circulation
[3]mitigated through project design and controls
[4]temporary increase in turbidity during construction; longer-term impacts considered under obstruction of flow/circulation

Notes:
N/A = not applicable
O = operations
S = summer construction
W = winter construction
Y = potential consequence

4.1.1 Air Quality

Effects on local air quality will occur during export pipeline construction and operations and will most likely be due to emissions from vehicles, aircraft, machinery, generators, and compressors. Air quality impacts may also include effects of dust from placement during construction of the potential gravel valve pads and from dust generated by vehicles during both construction and operations.

4.1.1.1 Emissions

The Point Thomson Gas Cycling Project activities have the potential to produce the following regulated air pollutants: nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter, and volatile organic compounds (VOCs). The type and amounts of air pollutants expected from this project will differ under construction and operations phases.

Winter and Summer Construction

Sources of emissions possible during both winter and summer construction phases include:

- Heavy construction equipment including gravel-hauling dump trucks
- Construction support equipment including cranes, pumps, generators, compressors, pile drivers, welders, and heaters
- Vehicles, vessels (in summer), helicopters, and airplanes used to transport equipment, materials, and personnel to and from Point Thomson

The main emission from these sources will be NOx, with lesser amounts of CO, SO_2, and particulates. Vehicle, vessel, and airplane emissions are expected to consist mainly of CO with small amounts of VOCs from aviation and other fuels.

Construction emissions will be temporary and will not contribute to long-term air quality issues. Emissions will be quickly dispersed by the frequent winds common to the area. Anticipated project emissions will be identified in the Air Quality Permit to Construct submitted to the Alaska Department of Environmental Conservation (ADEC). It is anticipated that there will be no significant, long-term, adverse effects from the construction emissions.

4.1.1.2 Dust

Placement of gravel fill material for the potential valve pads is not likely to generate large concentrations of airborne dust. Because this construction activity is expected to occur during the winter months, minimal dust will be generated from the frozen materials. It may be necessary to regrade the potential valve pads during the first summer construction period. This activity will likely result in increased airborne dust particles, and a temporary reduction in air quality in the immediate vicinity of the activity. To mitigate the dusty conditions, water will be used to wet the areas prior to regrading. Long-term effects from the initial regrading and compaction activities are not anticipated.

4.1.2 Surface Hydrology and Fresh Water Quality

Impacts to drainage patterns and surface hydrology can occur when placement of gravel for the potential valve pads diverts, impedes, or obstructs flow in stream channels or wetlands. Water quality impacts to freshwater lakes and streams can occur due to this obstruction of flow, and also can occur as a result of discharges and spills, water removal, and gravel removal (see Table 4-1). Effects can be in the form of temporary or long-term blockages to the drainage patterns, or degradation of freshwater quality.

4.1.2.1 Placement of Gravel and Obstruction of Flow

Impacts due to obstruction of flow and placement of gravel are combined when discussing surface hydrology and fresh water quality because these actions are related. During construction, temporary or long-term disruption of natural drainage patterns could occur if gravel for the valve pads is placed on the tundra. The potential effects of construction and the subsequent presence of the pads and pipeline on surface hydrology and freshwater quality could be:

- Blockage of natural drainage patterns and overland sheet flow by pad embankments, resulting in seasonal or long-term impoundments on the upstream side and drying downstream of the embankment. Proper location of culverts and/or berm breaks can mitigate these effects. In addition, any valve pads would likely be small as compared to the large pads planned for the drill sites and CPF (see ER). Therefore, impacts due to placement of gravel for the valve pads are expected to be negligible.

- Acceleration of flow by berm breaks and subsequent erosion (scour) of disturbed ground. Soils within the study area tend to be ice-rich sands and silts that erode easily. Proper siting and design of valve pads can help mitigate these effects.

- Obstructions or diversions in the sheet or stream flow can impact freshwater quality. If the water exchange between ponds is disrupted due to flow obstructions, streams or creeks may no longer provide favorable habitat for fish or vegetation. Proper siting and design can mitigate effects.

Impacts on local drainage patterns can also occur due to the presence of ice roads. The presence of an ice road can result in delayed snowmelt and tundra compaction. The effects of delayed snowmelt are confined primarily to the first summer season following use of an ice road, where as effects of tundra compaction may persist. A delay in snowmelt can cause water flow obstructions during spring breakup. This effect will be mitigated by breaching the ice road at the drainage locations as needed during breakup to allow flow. After each of the first and second construction seasons, ice roads will be abandoned and allowed to melt. While some ponding might occur during a rapid onset of snowmelt, melt-water channels can cut through naturally occurring river aufeis (overflow icing) and rapidly drain the impounded water (Sloan et al. 1975). Should onshore ice roads be used in the future, they could be offset somewhat from year to year, the minimizing any effects of these short-term impoundments.

The export pipeline will be elevated above the drainages or water bodies on VSMs. Large lakes and ponds will be avoided as much as possible. By having the pipeline elevated over the drainages, effects due to blockage of flow will be minimized.

4.1.2.2 Discharges

Impacts to fresh water quality can occur as a result of discharges during construction and operations activities. During pipeline construction, pipeline hydrotest water may be a permitted discharge.

Accidental discharges due to small spills could occur during both construction and operation of the export pipeline. These small spills typically consist of diesel fuel and other fluids necessary for vehicle operations and other chemicals stored onsite that are used in the process modules and other facilities. Impacts from large spills are considered in the project ODPCP Plan.

Permitted Discharges

The export pipeline will be hydrostatically pressure-tested, as discussed in Section 2.3.2.7. If not completed during the winter construction period, hydrotesting activities may be performed during the summer and fall before the start of production. Three scenarios are being considered:

- Drawing fresh water from local water sources, and filtering and discharging the water to tundra after hydrotest (as authorized under the applicable National Pollutant Discharge Elimination System [NPDES] permit).

- Using seawater, and filtering and discharging the water back to the ocean after hydrotest (as authorized under the applicable NPDES permit).

- Using a glycol/water mixture, and disposing of the mixture after use in the Point Thomson disposal well or sending it to Prudhoe or other suitable facility for recycling.

Hydrotest discharge location(s), amount(s), and characteristics will be regulated under an NPDES permit. Hydrotest discharges will meet then NPDES requirements; therefore, adverse effects to freshwater quality are not expected.

Spills and Leaks

Construction equipment, vehicles, and vessels are typically powered by diesel fuel. In addition, diesel generators will provide power until the gas-fired turbine generators are brought on line. Helicopters and aircraft could also require that a source of aviation fuel be available on site. Vehicles may also be required to access the pipeline for routine operations and maintenance or during an emergency situation. All storage of fuels and refilling of equipment and machinery during construction and operation phases will be conducted following the fuel transfer guidelines and liner use procedures outlined in Section 7 of the North Slope Environmental Field Handbook (BPXA and Phillips Alaska Inc.) and the refueling guidelines provided in Section 17 of the ExxonMobil Production Company Safety Manual. All employees will be trained in the proper methods and authorized locations for refueling. By limiting the locations of fueling and instituting controls for fueling methods, small spills and leaks can be prevented. Stored fuels have the potential to spill or leak and can cause temporary or long-term damage to fresh water quality. Fuels for construction equipment will be properly stored in approved containers in lined, bermed areas.

Ice roads can contain trapped contaminants from vehicle exhaust, antifreeze, oil, and other vehicle-related fluids. These contaminants could enter into the water system(s) each spring as the ice roads melt. The discharge is not anticipated to be significant, and since ice roads are only planned for the first two winter construction periods, and would potentially produce only short-term effects. Mitigation will include regular inspection for and clean up of road spills, scraping of the affected road surface and proper disposal of the scraped materials prior to breakup will further minimize effects.

4.1.2.3 Water Removal

Freshwater sources are required to construct onshore and offshore ice roads for project access during winter construction activities. At present, a sea ice road connecting the Point Thomson facility to Endicott is not planned for every year; however, use of such an ice road may be required occasionally in the future. Water removed from area lakes to create onshore ice roads during winter will recharge area lakes when it melts in spring.

Many of the lakes are shallow and freeze to the bottom each winter. These lakes could only serve as water sources early in the winter in the project area. Several lakes, which may be deeper, have been identified as suitable potential water sources (see Figure 4-1).

Since there are few deep lakes in the region, former mine sites that have now filled with freshwater such as the former mine sites at Badami, Shaviovik Pit, and Point Thomson may be the best sources of year-round freshwater. These sources would not freeze to the bottom and may be suitable as water sources for ice road construction and maintenance throughout the winter. However, these waterbodies could support overwintering fish populations. In the winter, these ice-covered lakes could have low oxygen levels and could be subject to further reduction of oxygen if large volumes of water were removed. Low oxygen levels can be detrimental to the health of fish-bearing lakes, and affect the optimal overwintering habitat for fish. Permit stipulations for the Point Thomson project could limit the amount of freshwater allowed to be withdrawn from area lakes that are found to be fish bearing. For similar projects in the past, water withdrawal has been limited to 15 percent (%) of the available free water under the ice.

During summer construction and throughout the operations period, fresh water will be needed to minimize dust generation on the roads, for human consumption, and for other facility requirements. This water will be obtained from a permitted water source, likely the former gravel mine; and it is anticipated that there will be minimal to no effect to freshwater quality during the summer months. Table 4-2 provides previously permitted volumes for water sources used for earlier activities in the Point Thomson area and developments to the west.

TABLE 4-2
EXAMPLE PERMITTED VOLUMES FOR WATER SOURCES IN THE POINT THOMSON AREA AND TO THE WEST

WATER SOURCE	GENERAL LOCATION	CURRENT/ PAST BPXA PERMIT #	PERMITTED VOLUME TOTAL FOR ALL SOURCES (CURRENT OR PAST)	ESTIMATED VOLUME (GAL)	ADF&G RESTRICTIONS?	COMMENTS
Duck Island Mine Site	Endicott Road	LAS 13290	221 acre-ft per year (72,000,000 gal)	600,000,000	Yes	Past permitted volumes based on need rather than availability
Sag Mine Site C (Vern Lake)	Endicott Road	LAS 13629		792,000,000	Yes	
Badami Reservoir	Badami Development	LAS 19045	61.6 acre-ft per year (20,000,000 gal)	86,000,000	Yes	Drinking water source
Turkey Lake	South of Badami CPU			730,000	No	Relatively shallow lake
Shaviovik Pit	Shaviovik River Delta, west of Badami CPU	LAS 14042	1125.27 acre-ft per year (370,000,000 gal)	125,000,000	No	Typically used in ice roads to Badami
Point Thomson Old Mine Site	Point Thomson Unit development area			104,000,000	Unknown	
Unnamed Lake	Point Thomson Unit development area (Sec. 22 & 23, south of airstrip)			923,000	No	Used for Yukon Gold and Sourdough ice roads

4.1.2.4 Gravel Removal

Gravel removal operations will be conducted only in the winter when frozen soils and tundra will be encountered. Impacts on surface hydrology and nearby freshwater quality will be mitigated by the frozen conditions. No increase in sedimentation is expected due to the removal operations. A gravel stockpile containing about 200,000 cubic yards (cy) (153,000 cubic meters [m^3]) will provide for future operations and maintenance needs. Potential runoff from the overburden pile, which could increase the suspended sediment of nearby waters, could be controlled if necessary. Control measures could include collecting the runoff and allowing the solids to settle before draining to the nearby tundra.

4.1.3 Permafrost and Soils

If allowed to thaw, the dominant ice-rich permafrost soils in the project area, will slump and release melt water, and then could pond. The ponded water will absorb more solar energy and increase the area of thawed soils. Thermokarst is the term used for this land-surface configuration that results from the melting of ground ice in a region underlain by permafrost. In areas that have appreciable amounts of ice, small pits, valleys, and hummocks are formed when the ice melts and the ground settles unevenly. Thermokarst areas can continue well beyond the area of initial disturbance and may take several years to stabilize, even if the soils are only slightly disturbed. The placement of 5-ft (1.5 m) thick gravel on the tundra surface to support project facilities will prevent the degradation of the permafrost. Gravel removal at the mine site location will impact the permafrost in the immediate vicinity.

4.1.3.1 Placement of Gravel

Any gravel placement for valve pads will take place during the winter months. Valve pads will have a working surface of approximately 5-ft (1.5 m) or more above ground level after compaction, depending on local topography. The active layer beneath the gravel will be reduced to a narrow zone near the existing ground surface. This reduction of annual thaw into the ice-rich soils reduces the risk of thaw settlement under the gravel fill, and degradation of permafrost. Consequently, effects to the permafrost will are likely to be minimal.

4.2 BIOLOGICAL RESOURCES

Biological resources of the Point Thomson area that could be impacted by construction and maintenance of the export pipeline include vegetation and wetlands, freshwater and marine fish, birds, marine mammals, and terrestrial mammals. The export pipeline activities and the impacts they could potentially produce are likely to be different whether the action occurs as part of winter or summer construction or during operations. Therefore, the potential impacts on the resources due to project actions during different pipeline project phases (winter and summer construction and operations) are considered separately. The potential direct and indirect effects of construction and operation activities associated with the export pipeline on biological resources can be grouped into three major categories:

- **Habitat Effects**
    - Long-term habitat loss or alteration from gravel placement for the construction of valve pads.
    - Temporary habitat modification leading to temporary or localized habitat loss or decreased habitat value. Effects could include changes in wildlife use of habitats that would be altered by ice roads, dust fallout, persistent snow drifts, thermokarst, alteration of water flow, impoundments, and contaminant spills.
- **Disturbance Effects**
    - Impacts associated with behavioral reactions of wildlife to noise and visual disturbance from equipment operation and human activity (e.g., vehicles, heavy equipment, and aircraft) during project construction and operation. Effects could include energetic and other costs associated with startle responses or with fleeing from the area, and reduced nesting success or clutch sizes of birds nesting too close to facilities.
    - Effects associated with loss of habitats (through avoidance or displacement), or reduction in quality of habitats in which wildlife are subject to disturbance.

- Attraction of wildlife to project facilities (e.g., herbivores to areas of early snowmelt in spring, birds to impounded areas adjacent to potential gravel valve pads, caribou to potential gravel valve pads and pipelines for insect relief, and predator/scavengers to artificial food sources). Other effects could include increased abundance of opportunistic and easily habituated predator/scavengers, including Arctic foxes, grizzly bears, glaucous gulls, and ravens.

- **Direct and Indirect Mortality**
  - Effects associated with loss of habitats (through avoidance or displacement), or reduction in quality of habitats in which wildlife are subject to disturbance.
  - Injury and mortality of wildlife from collisions with aircraft, vehicles, or structures, or from contact with, or ingestion of, oil or other contaminants
  - Increased predation on prey species by foxes, bears, glaucous gulls, and ravens as a result of their increased abundance, or attraction to oil field facilities.

4.2.1 Vegetation and Wetlands

As described in Section 3.4, about 35.3% of the project area is covered by water.Predominant vegetation types are moist sedge, dwarf shrub/wet sedge tundra complexes, and moist sedge, dwarf shrub tundra. Table 4-3 provides the linear ft of proposed Point Thomson project pipeline corridors in each vegetation type. The proposed export pipeline corridor is expected to cross a total of 113,158 linear feet of all vegetation types, approximately 83% of which consists of the moist sedge, dwarf shrub tundra/wet sedge tundra complexes and moist sedge, dwarf shrub tundra mentioned above.

4.2.1.1 Habitat Effects

Habitat effects in the project area depend upon the relationships between available habitat and resident wildlife species. Although the availability of food, nesting sites, and competition for habitat becomes restrictive at some threshold, there are no data currently available that indicate this threshold has been reached such that tundra habitat limits the size or natural growth rates of the wildlife species (Maki 1992).

Habitat effects can be considered long-term or temporary. Long-term effects occur when tundra is lost due to being covered with gravel. Temporary or short-term alterations of tundra vegetation in the Point Thomson area could be caused by ice roads, dust fallout from potential gravel valve pads, snow dumps, persistent snowdrifts, thermokarst, changes to surface hydrology, and spills and leaks during construction and operations phases.

Gravel Placement

Direct impacts to the vegetation and wetlands of the Point Thomson proposed export pipeline corridor area will occur if gravel is placed on the tundra during winter construction of potential valve pads. The effects of gravel cover are long-term and vegetation recovery is slow following removal or remediation of gravel fill (Johnson 1987, Walker et al. 1987, and Jorgenson et al. 1991). Therefore these effects are considered to be long-term. The vegetation types most affected by gravel placement would be moist sedge, dwarf shrub tundra (39% of the gravel footprint lies in this vegetation type) and moist sedge, dwarf shrub tundra/wet sedge tundra complex (36% of the footprint). No other vegetation type comprises more than 5% of the gravel footprint for the Point Thomson project.

Ice Roads

For the proposed Point Thomson Gas Cycling Project, ice roads on tundra will be used during the second winter for pipeline construction. Ice roads typically result in delayed snowmelt and tundra compaction. The effects of delayed snowmelt are confined primarily to the first growing season following use of an ice road. Although some damage to tundra occurs from ice roads, the long-term effects are considerably less than those associated with pads. The magnitude of impacts will depend on the volume of ice in the underlying soil (Adam and Hernandez 1977), the vegetation type present (Racine 1977; Walker et al. 1987, Emers et al. 1995), and the duration of use (Buttrick 1973, Adam and Hernandez 1977).

Ice roads can result in torn and crushed sedge tussocks, and mortality of mosses and lichens (Adam and Hernandez 1977, Johnson and Collins 1980, Walker et al. 1987). Some individual plants may be killed or small areas damaged, but if the tundra organic mat is not torn, plant recovery usually occurs within a few years. However, removal of plant cover (ripped or scraped) or disruption of the soil surface can cause long-term damage or mortality to plants. The effects of ice roads are greater in dry and moist habitats than they are in wet habitats. Based on the pipeline alignment, the vegetation types with the largest proportion of ice road coverage would probably be moist sedge, dwarf shrub tundra/wet sedge tundra complex (37% of pipeline alignment) and moist sedge, dwarf shrub tundra (42% of pipeline alignment; Table 4-3). Areas that are most sensitive to damage from ice roads include ridges, banks, dunes, tussocks, and high centered polygons, which are most common in the following vegetation types: moist sedge, dwarf shrub tundra; moist tussock sedge, dwarf shrub tundra; dry dwarf shrub, crustose lichen tundra; dry dwarf shrub fruticose lichen tundra, and dry barren/dwarf shrub, grass complex. A total of 85,726 linear ft (26.1 kilometers [km]) of the pipeline alignment lies within these vegetation types.

Water Removal

Withdrawal from lakes could potentially alter wetland community structure by changing the hydrologic regime. Potential lakes identified for ice road construction are shown in Figure 4-1.

Table 4-3 Linear Feet of Proposed Point Thomson Project Pipeline Corridors in each Vegetation Type

VEGETATION TYPE	LEVEL C VEGETATION CLASS	EAST PIPELINE	SALES PIPELINE	WEST PIPELINE	SUBTOTAL	% OF TOTAL
Water	Ia	2,424	6,070	2,845	11,339	6.34
Salt Marsh		183	187	189	559	0.31
	IIIb				*0*	*0.00*
	Ixh				*0*	*0.00*
	Ixi	*183*	*187*	*189*	*559*	*0.31*
Aquatic Graminoid Tundra	Iib	483	948	937	2,368	1.32
Water/Tundra Complex	Iid		549	567	1,116	0.62
Wet Sedge Tundra	IIIa	1,293	2,490	813	4,596	2.57
Wet SedgeTundra/Water Complex	IIIc		2,727	564	3,291	1.84
Moist Sedge, Dwarf Shrub Tundra/ Wet Sedge Tundra Complex		9,182	45,073	12,325	66,580	37.23
	IIId	*2,408*	*7,835*	*5,555*	*15,798*	*8.83*
	IIIe	*96*	*302*	*148*	*546*	*0.31*
	Iva	*6,677*	*36,936*	*6,622*	*50,236*	*28.09*
Moist Sedge, Dwarf Shrub Tundra		12,613	49,106	13,987	75,706	42.33
	Va	*11,720*	*38,263*	*13,130*	*63,112*	*35.29*
	Ve	*893*	*10,844*	*857*	*12,594*	*7.04*
Moist Tussock Sedge, Dwarf Shrub Tundra	Vb				0	0.00
Dry Dwarf Shrub, Crustose Lichen Tundra	Vc	2,782	3,229	3,010	9,020	5.04
Dry Dwarf Shrub, Fruticose Lichen Tundra	Vd		1,000		1,000	0.56
Dry Barren/Dwarf Shrub, Forb Grass Complex	Ixb				0	0.00
Dry Barren/Forb Complex	Ixc				0	0.00
Dry Barren/Grass Complex	Ixe				0	0.00
Dry Barren/Dwarf Shrub, Grass Complex	Ixf				0	0.00
River Gravels	Xa	41	781	49	870	0.49
Bare Peat, Wet Mud		715	1,000	693	2,407	1.35
	Xia	*715*	*1,000*	*693*	*2,407*	*1.35*
	Xic				*0*	*0.00*
Gravel Roads and Pads (and washouts)		0	0	0	0	0.00
	Xc				*0*	*0.00*
	Xe				*0*	*0.00*
Total		**29,715**	**113,158**	**35,979**	**178,852**	**100.00**

SUM = LENGTH (Units = Feet)

Obstruction of Flow

Impoundments (and other alterations of water flow) can occur when drainage is impeded adjacent to potential valve pads. Impoundments can be temporary, disappearing by mid-June, or they can persist through summer. Depending on the duration of seasonal impoundments, effects on vegetation range from minor to substantial. If the valve pads are large enough, culverts will be placed during construction to prevent the formation of long-term impoundments. Additional culverts or other drainage structures could be installed after construction to drain any long-term impoundments that might form following initial gravel placement. However, it is anticipated that the valve pads will be small enough and located such that drainage impacts would be minimal and could be mitigated with berm breaks. Temporary impoundments may occur for brief periods (a week or less) during spring runoff; however, the overall effects of such impoundments on vegetation would be minimal.

Thermokarst

As described in Section 3.4, thermokarst is the settling or caving of the ground due to melting of ground ice (Muller, 1947). Thermokarst is a natural process, even in undisturbed areas, and can be viewed as having both positive and negative effects. The process occurs whenever the heat absorption or exchange capacity of permafrost soils is altered. Thermokarst areas are typically found on the edges of gravel pads or roads, and are exacerbated by dust fallout or impoundment of water. Thermokarst also can result when the tundra mat is disturbed, often as a result of spill cleanup activities. Although visual and hydrologic effects of thermokarst are long-lasting (Lawson 1986), other ecological changes may benefit plant productivity and wildlife use (Truett and Kertell 1992). Physical and thermal changes may enhance organic matter decomposition, nutrient release, primary production, and nutrient concentrations in plant tissue (Challinor and Gersper 1975, Chapin and Shaver 1981, Ebersole and Webber 1983, and Emers et al. 1995). Thermokarst may increase habitat diversity, species richness, and plant growth on thin gravel fill (Jorgenson and Joyce 1994). Since the valve pads would be at least 5 ft thick to insulate ice-laden soils, thermokarst conditions are not expected.

Dust Fallout

During the summer construction season, the potential gravel valve pads may be graded and compacted. These activities could generate small amounts of dust. However, any impacts on the surrounding vegetation would be extremely localized and not significant.

Snow Dumps and Snow Drifts

During the winter, snow that accumulates on the valve pads would likely be pushed off the gravel surface and allowed to accumulate on the frozen tundra. The accumulated snow can result in delayed snowmelt and soil compaction. Impacts on vegetation may be long-term because of the chronically reduced growing season, soil compaction, altered moisture regime, and gravel fallout. However, since large accumulations of snow are not anticipated for the region, and the areal extent of the valve pads is likely to be small, any areas potentially affected by snow dumps and snowdrifts associated with the pads would be minimal.

Spills and Leaks

Contaminant spills associated with the Point Thomson project could affect plant communities in several ways. The most common accidental spills in the North Slope oil fields are fuels and vehicle/machinery lubricants, although a wide range of other chemicals are used in the industry and may be spilled accidentally (e.g., methanol, glycol). Impacts to vegetation range from minor to severe, depending on the toxicity of the product spilled and the measures taken to clean it up. For the most common spills in the oil field, predictable alterations in the plant community include decreased plant cover, decreased species richness, mortality of woody plants and herbaceous flowering plants, increased relative abundance of graminoid plants (grasses and sedges), and thermokarst and associated changes (ranging from increased to decreased hydrologic variability). The most common spills on the North Slope are relatively small and can be cleaned up with minimal impact on vegetation. Reasonably productive plant cover can be achieved within several years, with some rehabilitation effort. Impacts from large spills or a pipeline leak/rupture are considered in the project ODPCP Plan.

4.2.1.2 Disturbance and Mortality Effects

While mortality of vegetation and disturbance to vegetation and wetlands will occur as gravel is placed on the tundra, these direct impacts are discussed in the context of habitat loss and/or alteration (see Section 4.2.1, above).

4.2.2 Fish

4.2.2.1 Habitat and Disturbance Effects

Project activities that alter quality or quantity of fresh or marine water, in turn, have potential for altering habitats of freshwater and marine fish. Arctic cisco (*Coregonus autumnalis*), least cisco (*C. sardinella*), broad whitefish (*C. nasus*), and humpback whitefish (*C. pidschian*) are not known to overwinter or spawn in the area of the proposed export pipeline ROW. Project activities associated with the export pipeline are not planned close to these areas and, therefore, will not directly impact the overwintering and spawning habitats of these fish species.

Winter Construction

Gravel placement for potential valve pads for the export pipeline is not expected to alter flow patterns of streams and wetlands, and therefore should not prevent fish from accessing any habitats and/or modify any fish habitat. Perched lakes can provide overwintering and rearing areas for fish, but there is rarely a defined channel from perched lakes to river channels; the connection is generally through low-lying wetlands. Ninespine stickleback are likely be found in streams and rivers in the Point Thomson proposed export pipeline ROW area (Section 3.5); however, there are no known perched lakes or streams deep enough to provide ninespine stickleback overwintering or spawning habitat in the project area (see Figure 4-1). Consequently, it can be concluded that gravel placement for pads will not impact ninespine stickleback overwintering and spawning habitats.

Pipelines will be constructed during winter using onshore ice roads. Turbidity associated with construction activities required to place vertical support members (VSMs) in small creeks and defined drainages along the pipeline route is expected to be temporary. It is also anticipated that most if not all of these small drainages will be frozen to the bottom, and thus there will be no effects on water quality. Gathering and export pipelines are not expected to cross any streams or drainages that support overwintering fish.

Summer Construction

Re-grading and compaction of potential gravel valve pads for the export pipeline during the first summer construction period may cause disturbance to resident fish populations. Habitat effects due to dust and sediment entering freshwater and marine fish habitats include increased turbidity. However, any impacts are expected to be extremely limited and localized due to the anticipated small size of these pads Therefore, potential effects due to re-grading and compaction activities are expected to be short-term and similar to naturally occurring events in both freshwater and marine environments.

Operations and Maintenance

Vehicular traffic and maintenance of the potential gravel valve pads surfaces may cause dust to enter freshwater and marine fish habitats. Watering of gravel surfaces, low traffic volumes during operations, and enforcement of vehicular speed limits will minimize the generation of dust from operations traffic and gravel maintenance activities on fish habitat. Potential effects from dust and sediment drift to freshwater and marine waters are anticipated to be minimal and within naturally occurring turbidity variation in the freshwater and marine environments (e.g., disturbance from ice, river runoff from spring break-up, and storm induced waves).

4.2.2.2 Mortality Effects

Water removal during winter for ice road construction could potentially affect freshwater fish overwintering habitat in deep tundra lakes. Under-ice dissolved oxygen concentrations in lakes on the North Slope decrease over the winter. Excessive water withdrawal during the winter may adversely affect overwintering fish populations in deep tundra lakes. However, recent water use permits for North Slope developments have limited winter water withdrawal to 15% under-ice water volume in fish bearing lakes to minimize the potential for significant impacts to overwintering fish. This limitation on permitted water withdrawal volumes is considered conservative and, consequently, adequately protective of fish species that overwinter in these lakes. Accordingly, it is not anticipated that water withdrawal from identified potential water sources (see Figure 4-1) will have adverse effects on overwintering freshwater fish.

Sport fishing conducted by personnel in area streams and rivers may cause mortality due to direct take of fish species. All personnel will be required to comply with applicable ADF&G sport fishing regulations.

Contaminant spills associated with pipeline construction and operations may affect freshwater, diadromous, or marine fish species. Minor spills associated with winter construction and year-round drilling operations can be readily contained and collected. Contaminant spills associated with operations and maintenance are also expected to be minor and inconsequential. Personnel will be trained in spill prevention and cleanup procedures. It is not anticipated that freshwater or marine fish habitat will suffer long-term adverse effects due to minor contaminant spills. Impacts from large spills are considered in the project ODPCP Plan.

4.2.3 Birds

4.2.3.1 Habitat Loss and Alteration

Loss and/or alteration of bird habitat can be either long-term (i.e., due to burial by gravel placement for pads) or temporary. Temporary loss and alteration of bird habitats could result from ice roads, dust fallout, snow dumps, persistent snowdrifts, thermokarst, impoundments, and contaminants.

The export pipeline activities are anticipated to potentially cause only temporary loss due to ice road construction.

Gravel Placement

The area of habitat altered by the possible construction of valve pads along the proposed export pipeline corridor is expected to account for a very small percentage of this total area. Any required valve pad construction will occur during winter. The most affected vegetation types would be moist sedge, dwarf shrub tundra/wet sedge tundra complex, and moist sedge, dwarf shrub tundra, which together comprise 79% of the project footprint.

Important bird habitats in the Point Thomson area are primarily those containing wet tundra and those with aquatic (ponds/lakes) components that provide food, shelter, and escape cover from predators (water, aquatic graminoid tundra, water/tundra complex, wet sedge tundra, and wet sedge tundra/water complex). Salt marsh is another important, but rarer, vegetation type in the Point Thomson area, and is used by brood-rearing geese (brant, and snow geese) and shorebirds. Although most bird species in the region exhibit fidelity to nesting areas, studies in the Prudhoe Bay oil field indicated that most birds who lost nest sites to gravel placement were not prevented from nesting in subsequent years, but shifted their nesting efforts to adjacent, undisturbed habitats (Troy and Carpenter 1990, and Troy 2000). In general, the amount of habitat lost due to the Point Thomson export pipeline will be negligible relative to regional habitat abundance. Therefore, no impacts of long-term habitat loss for birds are expected due to construction and operation of the pipeline.

Ice Roads

Ice roads will be used during winter pipeline construction, and potentially on an occasional basis for pipeline maintenance throughout the life of the project. Ice roads do not melt until after most bird species begin nesting (late May–early June), thereby reducing the availability of nesting sites. In addition, compaction of standing dead vegetation reduces cover needed by most birds for nesting sites. The effects of temporary losses of habitat due to ice roads for the Point Thomson project are anticipated to be minor, as displaced birds would likely nest in adjacent, unaffected habitats. In addition, the effect would be limited to the summer after construction.

Water Removal

Withdrawal of water from lakes could potentially alter wetland community structure by changing the hydrologic regime. A change in regime could potentially affect bird use of waterbodies as nesting areas or as brood-rearing habitat. The changes could alter plant and invertebrate community structures, potentially decreasing the value of habitats used by waterbirds for cover or food. Waterbirds that nest on small islands within tundra lakes could be affected if spring recharge is insufficient to compensate for water withdrawn the previous winter. Potential lakes identified for ice road construction water use are identified in Figure 4-1. As described in Section 4.1.2.3, these lakes will be permitted and permit stipulations will likely limit the amount of freshwater withdrawal. It is assumed that permitted water withdrawal limits are conservative and protective of affected waterbodies.

Obstruction of Flow

Impoundments (and other alterations of water flow) can occur when drainage is impeded adjacent to gravel pads. Impoundments can be temporary, disappearing by mid-June, or they can persist through summer. Depending on the duration and extent of seasonal impoundments, the effects on bird habitats can range from minor to substantial. Water impounded by gravel pads both displaces and attracts birds, depending on the species (Troy 1986;, Kertell and Howard 1992;, Kertell 1993, 1994;, and Noel et al. 1996). Temporary impoundments preclude nesting by some species (Walker et al. 1987) but may be used by others (e.g., Pacific loon [Kertell 2000]; geese, loons, eiders [Noel et al. 1996]). For the Point Thomson export pipeline project long-term impoundments adjacent to valve pads are not expected (see Sections 4.2.3 and 4.2.4). There is a slight possibility that temporary impoundments could occur (lasting a week or less) during spring runoff, but these impoundments would be extremely localized and any impacts on birds would be negligible.

Spills and Leaks

Contaminant spills and cleanup efforts can alter bird habitats in various ways. However, the most common spills are relatively small in quantity and affect small areas of tundra. The Point Thomson project is not anticipated to result in population-level effects attributable to habitat alteration by small contaminant spills. Impacts from large spills are considered in the project ODPCP Plan.

4.2.3.2 Disturbance Effects

Potential disturbance effects include immediate behavioral responses of affected birds (including energetic or other costs associated with startle or fleeing responses), loss of habitats or degradation of habitat quality (by causing avoidance), and attraction of some species to areas of human activity (particularly predators/scavengers).

Winter Construction

Winter construction activities will occur during 2004 and 2005 and will include ice road construction gravel placement for potential valve pads, and pipeline installation. Because most birds are absent during winter months, these activities are unlikely to cause disturbance effects for most species.

Summer Construction

Summer construction activities associated with the export pipeline are expected to be minimal, but may include valve pad regrading, and pipeline post-construction testing.
Based on these potential disturbances, a small percentage of birds could show short-term alterations in their behavior. However, effects on nesting success are not anticipated.

Operations

Glaucous gulls and common ravens are attracted to garbage and food handouts at human settlements and camps. Although adequate historical records are lacking, biologists generally agree that the populations of these two species have increased because of the availability of these foods from the North Slope oil field operations. Ravens and some raptors are now known to nest on buildings (particularly ravens on processing facilities) and other structures in the existing oil fields, including elevated pipelines (Ritchie 1991 and ABR, Inc., unpublished data). Raptors, gulls, ravens, ptarmigan, songbirds, and shorebirds all perch on elevated pipelines, and snow buntings nest in VSM supports and buildings. The presence of the Point Thomson facilities may cause minor increases in populations of scavenging birds, if any edible garbage is available at the facility. Snow buntings, raptors, and ravens may nest or roost on new buildings and pipelines built for the

Point Thomson Gas Cycling Project. Proper handling and disposal of camp solid wastes will serve to partially mitigate the attraction factor.

4.2.3.3 Mortality Effects

Waterfowl and other birds occasionally collide with oil field structures, including buildings and towers, guy-wires for antennas, and power poles and wires. There is also a slight potential that birds could collide with the export pipeline itself. Bird strikes are most common in areas where large numbers of birds aggregate or pass during migration, such as points of land along the coast, or lagoon molting areas. The incidence of bird strikes also increases during periods of low visibility due to fog or darkness. Species in the Point Thomson area that could experience strikes with pipeline include long-tailed duck, common eider, and brant, all of which would be abundant in the area during molting or migration periods. However, the incidence of actual strikes is expected to be very low and overall, there is no potential for bird strikes to have population-level consequences for any species in the area.

Increased predator populations in the vicinity of oil field developments may increase predation on bird populations (Martin 1997). This impact is inferred from the higher numbers and productivity of foxes (Eberhardt et al. 1982, Burgess et al. 1993, and Burgess 2000), grizzly bears (Shideler and Hechtel 1995b and 2000), and gulls and ravens (Truett et al. 1997 and Day 1998) in the North Slope oil fields. Gulls, ravens, and foxes prey on bird eggs and young, and foxes can also take adult birds. Bears have been known to take bird eggs. Foxes and grizzly bears often cause the complete failure of goose colonies during some breeding seasons in the North Slope oil fields (Burgess and Rose 1993, Burgess et al. 1993, Stickney et al.1993, Johnson 1994 and 2000, and Noel and Johnson 2001a and 2001b). Failure of the Howe Island snow goose and brant colony in six of the last ten years has been attributed to the increased abundance of Arctic foxes and bears in the region (Noel and Johnson 2001a and 2001b). Common eiders are the most abundant colonial nesting species in the Point Thomson area and exhibit susceptibility to Arctic fox predation during nesting (Quinlan and Lehnhausen 1982).

It is anticipated that refuse control efforts, employee environmental sensitivity training, and enforced rules against animal feeding would minimize population-level effects on predators and scavengers, and avoid the potential for these animals to negatively affect populations of birds in the Point Thomson area.

4.2.4 Marine Mammals

Marine mammals that may be encountered at various times of the year in the Point Thomson area include cetaceans (whales), pinnipeds (seals) and polar bears (see Section 3.7). The following sections describe the potential impacts of winter and summer construction efforts and operations activities on the habitat, disturbance, and mortality of polar bears and ringed seals. These are the only marine mammals that could experience impacts due to the construction and operations of the export pipeline.

4.2.4.1 Habitat Effects

Long-term habitat effects (loss or alteration) on polar bears are not expected due to winter or summer construction activities associated with the Point Thomson Gas Cycling Project. Habitat or denning sites for polar bears will not be impacted since the construction activities will avoid any active dens.

Short-term alteration of the marine habitat from winter and summer construction and traffic noise is discussed as disturbance to polar bears rather than as a habitat effect. Impacts of operations on polar bears are also expected to be related to disturbance. These impacts are discussed in the following sections.

4.2.4.2 Disturbance Effects

Winter Construction

Winter construction will occur during 2004 and 2005, with up to 450 people working with heavy equipment at any given time during this period (see Section 2.0). During winter construction and drilling efforts, numerous vehicle trips per day could take place on the sea ice road from Prudhoe/Endicott to the Point Thomson area. In addition, several helicopter and other aircraft trips could be reqnuired each day to support construction activities.

Disturbance to marine mammals present in Lion Bay and adjacent onshore areas during winter construction periods may result from noise from construction activities, drilling, aircraft and helicopter over-flights, and vehicle movement along sea ice roads. Construction activities that generate noise may include the placement of gravel if the construction of valve pads is necessary. However, it is expected that disturbance to marine mammals will be limited to traffic noise on the sea ice road that will be used to support export pipeline construction.

Pinnipeds

In winter and spring, ringed seals frequent land-fast ice and offshore pack ice. The highest densities of seals are usually found on stable shore-fast ice. Ringed seals maintain breathing holes throughout the winter in ice up to 6 ft (1.8 m) thick and dig multiple haul-out shelters and nursery lairs beneath the snow (Kelly 1988). It is possible that construction activities could impact individual seals using the area at the dock construction site. Pupping occurs in the spring, and it is unlikely that birthing lairs would be established by the time construction begins. The most likely impact to seals in the area would be displacement to other areas of shore-fast ice. Inupiat hunters continually stress that all marine mammals are sensitive to noise, and are careful to make as little extraneous noise as possible when hunting. Seals are also said to be cautious of any unusual visual stimulus, especially if the stimulus is in motion. At the same time, seals are said to be curious and will sometimes investigate unusual objects, and can be attracted by imitating the normal, non-vocal sounds that seals make on the ice. In short, seals are sensitive to their surroundings, especially responsive to sound, and tend to avoid unusual sounds. Industry and peer review findings are consistent with these traditional and local observations, and provide a qualified measure of this sensitivity to noise and other disturbance.

Seal reactions to construction activities are related to the noise of construction activities. Greene (1983) studied the underwater noise produced during construction of Seal Island, located 10 miles northwest of Prudhoe Bay. The island was built in 40-ft (12-m) of water compared to 0 to 12 ft (0 to 4 m) of water for the Point Thomson dock. He found that at 2.2 mi (3.6 km) from the Seal Island construction site, there was no evidence of propagation of noise components above 1000 Hertz (Hz), and little propagation of components below 1000 Hz (Greene 1983). Sea ice road construction in waters over 40 ft (12 m) deep produced potentially detectable low-frequency (<200 Hz) underwater noise as far as 2,624 ft (800 m) from the source (Greene 1983). Others have found that sound, especially at low frequencies, attenuates rapidly in shallow nearshore waters (Mi et al. 1987; Section 4.4 in Richardson et al. 1985). Thus, winter construction sounds propagate only a short distance in waters as shallow as those at Seal Island (40 ft [12 m]), and may propagate even less well in the nearshore zone at the proposed site of the Point Thomson dock.

The ability of seals and other marine mammals to detect anthropogenic noise is influenced by natural background (ambient) noise levels. Ambient noise is influenced by sea surface noise associated with waves (Fairbridge 1966). Some limited measurements of ambient noise under the ice near the Liberty Development were obtained during February 1997 (Greene 1997). Noise levels as measured were well below the reference values for "zero sea state" at all frequencies between 25 Hz and 5000 Hz. This is typical for an area of stable fast ice. Background noise, as influenced by "sea state", is lower under the ice.

The hearing abilities of these mammals are another factor affecting their potential responses to anthropogenic noise. The hearing abilities of ringed seals have not been measured at frequencies below 1 kiloHertz (kHz) (Terhune and Ronald 1975). Based on data from harbor seals, hearing sensitivity is expected to deteriorate with decreasing frequency to a threshold of about 96 decibels (dB) re 1 micro Pascal (µPa) at 100 Hz (Kastak and Schusterman 1995 and Richardson et al. 1995b). This means that the radius of audibility of low-frequency construction sounds to seals will be smaller than the radii within which these low-frequency construction sounds are detectable by sensitive hydrophones under low ambient noise conditions.

Green and Johnson (1983) found that seals apparently were displaced from the area within a few mi of Seal Island during the island construction in the winter of 1981-1982. Frost and Lowry (1988) similarly found seals avoiding areas within 2.3 mi (3.7 km) of artificial islands, and that avoidance was stronger, a 50 to 70 percent reduction in seal density, when island activity was high. However, more recent data described in LGL and Greeneridge (2001) showed that the construction of Northstar Island pipeline corridor and ice roads in late 19991 and early 2000 did not significantly affect the distribution or abundance of ringed seals. Seal densities in areas close to the Northstar development were similar to those found in non-construction impacted areas.
Since most of the Point Thomson construction effort is located on shore, there should be even less disturbance to seals from this project. Noise from vehicle movement along the sea ice road, which will be used to support construction of the export pipeline, is the only anticipated disturbance to seals during winter construction activities related to the export pipeline.

Polar Bear

Polar bear dens have been identified in the project area in the past (see Section 3.7.1). Females are occasionally found on land during the winter denning season. Construction and drilling activities can cause short-duration (one-or two seasons), but intense disturbances for polar bears denning near the center of activity. However, Amstrup (1993) found that 10 of 12 polar bears tolerated exposure to a variety of disturbance activities with no apparent effect on productivity. Polar bears may be more apt to abandon dens in response to disturbance early in the denning period (Amstrup 1993). Abandonment late in the denning period could have a greater impact. Amstrup and Gardner (1994) found that survival was poor for cubs that left dens prematurely due to movement of sea ice. Polar bears seeking a den site apparently prefer to find an alternate location rather than abandon a den and establish a new one elsewhere. Amstrup (1993) suggested that initiation of intense human activities during the period when polar bears seek den sites (October– November) could give bears the opportunity to choose less disturbed locations. All known areas of specific denning activity by polar bears have been avoided during design and siting of the project facilities and planned ice road routes.

Polar bears are thought to avoid loud noise sources, although there is no evidence that noise associated with construction or operations disturbs polar bears. Stirling (1988) reports that polar bears have commonly approached industrial sites in the Canadian Beaufort Sea region. Human/polar bear encounters have the potential to cause injury to both sides. Polar bears are curious and opportunistic hunters that have been known to approach facilities in search of food. As with grizzly bears and foxes, all operations in the project area will be conducted to minimize the attractiveness of the construction sites to polar bears and to prevent their access to garbage, food, or other potentially edible or harmful materials. All activities associated with polar bears in the region will be coordinated with the U.S. Fish and Wildlife Service (USFWS) and the ADF&G. Upon issuance of a Letter of Authorization from the USFWS, trained personnel have authority under Section 112(c) of the Marine Mammal Protection Act to haze/take polar bears under certain circumstances involving the protection of life.

Operations

Pinnepeds

Effects of operations of the proposed project and associated transportation on seals are expected to be limited to short-term and localized behavioral reactions by a small number of seals. Aircraft will avoid flying within 2 mi (3.2 km) of any identified spotted seal haul-out sites in or near the proposed project to mitigate potential effects of aircraft on these highly sensitive species. Overall, operations effects on individual seals or their populations will not be significant.

Polar Bears

The majority of effects from pipeline operations on polar bears will be in response to airborne noise. Operation of the facility will require transportation to the area by vessel and aircraft. In addition, the compressors, flares, and other equipment associated with condensate production will produce noise that could disturb polar bears in the area.

Operation of the Point Thomson Gas Cycling facility could require a few helicopter trips per week and daily trips by other aircraft, from Prudhoe Bay. There will be daily trips by vehicles on the infield roads to each of the well pads during operations. Levels and duration of noise from operations equipment (such as compressors, generators, and flares) would be expected to be similar to levels currently experience at Endicott where similar facilities are in operation.

Polar bears are extremely curious and opportunistic hunters, and they have been known to approach facilities in search of food. All operations in the project area will be conducted to minimize the attractiveness of the construction sites to polar bears and to prevent their access to garbage, food, or other potentially edible or harmful materials. A polar bear interaction plan using the MMS guidelines for operation within polar bear habitats will be developed and implemented (e.g. Truett 1993 and BPXA 1993a). All activities associated with polar bears in the region will be coordinated with the USFWS and the ADF&G. Trained personnel have authority under Section 112(c) of the Marine Mammal Protection Act to haze/take polar bears under certain circumstances involving the protection of life. This requires project-specific authorization from the USFWS.

The project will be operated in compliance with all applicable permits and regulations, which will further assure that the likelihood that impacts will occur to the species, stocks, and subsistence users of the species or stocks is minimized. During the summer, all helicopter operations will be conducted over land, to the extent practicable As appropriate, activities will be coordinated with the relevant federal and state agencies (particularly the National Marine Fisheries Service, USFWS, National Biological Service, and ADF&G), local authorities (North Slope Borough), communities (Barrow, Nuiqsut, and Kaktovik), and whaling captains and their representatives (Alaska Eskimo Whaling Commission; Barrow, Nuiqsut, and Kaktovik Whaling Captains Associations).

Mortality Effects

Mortality effects on marine mammals could be either direct due to construction or operations activities, or indirect due to attraction to predators that could then reduce populations of resident marine mammals. In the Point Thomson area, only direct mortality of polar bears is possible. Hunting of polar bears by project personnel will not be permitted. Should a polar bear encounter occur, it may become necessary to kill a threatening bear. This is most plausible during winter construction and operations since polar bears are not likely to be in the area during the summer. Mitigation measures such as polar bear interaction training and avoidance measures of polar bears and known polar bear denning areas, as well as managing wastes will help to reduce the possibility of this effect.

Regardless of the mitigation efforts, mortality to polar bears may occur during project operation. Operations will be conducted under small take provisions, including either (1) Incidental Harassment Authorizations (IHA) or (2) regulations and Letters of Authorization, or both, which will allow the take by harassment of small numbers of polar bears.

4.2.5 Terrestrial Mammals

Impacts due to habitat loss and alteration, disturbance, and mortality have been identified and are discussed in the following sections.

4.2.5.1 Habitat Loss and Alteration

Impacts to habitats used by terrestrial mammals can be either long-term (i.e., burial by gravel placed for pads) or temporary. Temporary loss and alteration of terrestrial mammal habitats could result from ice roads, dust fallout, thermokarst, impoundments, and contaminants. Activities related to the export pipeline that could cause habitat impacts include gravel placement, ice roads, and spills and leaks. It is anticipated that any impacts to habitats will be minor since the areas affected by these activities is expected to be small.

Gravel Placement

The construction of any potential valve pads along the export pipeline will occur during winter. The area of habitat altered by the possible construction of the gravel valve pads is expected to account for a very small area. Vegetation types that will be most affected by construction are moist sedge, dwarf shrub tundra/wet sedge tundra complex, and moist sedge, dwarf shrub tundra (together comprising 79% of the project footprint). Although these are important habitats for some mammal species (including caribou and lemmings), they are also the most abundant habitats in the Point Thomson area. In general, for all vegetation types affected the amount of habitat loss due to valve pads would be extremely small relative to abundance in the Point Thomson area Therefore, effects of long-term habitat loss due to gravel mine development and gravel road and pad construction for terrestrial mammals are anticipated to be minor.

Ice Roads

Onshore ice roads will be used during winter pipeline construction. Effects of ice roads on vegetation could include broken and abraded willows and mortality of lichens, both of which may have adverse consequences for terrestrial mammals. Shrub habitats are important for collared lemmings, voles, and large mammals such as moose, muskoxen, and caribou. However, the use of ice roads during winter pipeline construction is anticipated to have minimal impacts on terrestrial mammals because of the small area affected.

Spills and Leaks

Contaminant spills and cleanup efforts can alter mammal habitats in various ways. However, the most common spills in the oil fields are relatively small and affect small areas of tundra. Small spills occurring during construction and/or operations at the Point Thomson facility are not anticipated to result in population-level effects attributable to habitat alteration. Impacts from large spills are considered in the project ODPCP Plan.

4.5.5.2 Disturbance Effects

Potential behavioral disturbance includes immediate responses of affected animals (including energetic or other costs associated with startle or fleeing responses), loss of habitat or degradation of habitat quality (by causing avoidance), and attraction of some species to areas of human activity (particularly predator/scavengers). Point Thomson Gas Cycling Project export pipeline activities could cause either behavioral disturbance or attraction of wildlife during construction and main operations. The potential impacts are discussed under the context of winter construction, summer construction, and operations activities.

Winter Construction

Winter construction activities will occur during 2004 and 2005 and will include ice road construction, gravel placement for potential valve pads, and pipeline installation. Few caribou, muskoxen, grizzly bears, moose, and wolves are likely to be present in the Point Thomson area during the winter. Grizzly bears are also unlikely to be denning in the vicinity of the proposed project. Arctic fox and Arctic ground squirrels could be disturbed by construction activities if they were present in the area. It has not been determined to what extent these species make use of habitat in the project area. It is anticipated that any disturbance of small mammals present in the Point Thomson area during the winter will be minimal.

Year-Round Operations

Noise generated due to onshore construction activities and the physical presence of the pipeline has the potential to disturb terrestrial mammals in the area. Disturbance of muskoxen, grizzly bears, moose, wolves, and wolverines is anticipated to be minimal due to their infrequent use of the area.

Disturbance by traffic, structures, and human activities can produce several effects on caribou behavior and movement. During and immediately after the calving season, female caribou with calves tend to avoid areas near active pads and roads. However, the Central Arctic Herd has shifted its most concentrated calving areas several times over the last 20 years, with the most recent shift to an inland area southwest of the Point Thomson area and well outside of the proposed export pipeline ROW. The Porcupine Caribou Herd does not calve near the Point Thomson area.

During the insect season, harassment by insects overwhelms the avoidance response, and caribou of all ages and both sexes regularly approach and cross pipeline/road corridors while moving to and from insect-relief habitat located near the coast. The clearest behavioral impact of road traffic during insect season is reduced crossing success when caribou groups attempt to cross pipelines that are within 300 ft (91 m) of roads with high traffic rates (15 or more vehicles per hour) (Curatolo and Murphy 1986 and Cronin et al. 1994). The export pipeline will run parallel to the road connecting the CPF and West well pad for about 5 miles (8 km). Road and pipeline separation along this stretch is planned to be 300 ft. (91 m). The remainder of the export pipeline will not have an adjacent gravel road. To reduce disturbance impacts, research has focused on ways to facilitate free passage of caribou through the oil fields and standard mitigation measures have been developed (Cronin et al. 1994). The principal mitigative measure is to elevate pipelines to a minimum height of 5 ft (1.5 m). This often results in substantial lengths of pipe situated higher than 5 ft (1.5 m) as it crosses irregularities in the tundra surface. A pipeline constructed to the standard minimum height of 5 ft (1.5 m) above the ground surface (measured at the bottom of the pipe or vibration dampers, whichever is lower) does not impede caribou movements as long as a road with a high traffic rate is not located nearby (Curatolo and Murphy 1986, Cronin et al. 1994). Elevated pipelines at or above 5 ft (1.5 m) and pipeline/road separations of 300 ft (91 m) at the Point Thomson Project will minimize the impacts of behavioral disturbance of caribou. Foxes and bears are attracted to areas of human activity where they readily feed on garbage and handouts (Eberhardt et al. 1982, Follmann 1989, Follmann and Hechtel 1990, Shideler and Hechtel 1993, and Truett 1993). Opportunistic predator/scavengers such as Arctic foxes and grizzly bears appear to benefit from increased food resources in the oil fields (Burgess 2000 and Shideler and Hechtel 2000). When organic refuse is abundant, attracted foxes experience increased survivorship and higher reproduction rates (Eberhardt et al. 1982 and Burgess et al. 1993), leading to long-term increases in population size. The density of active Arctic fox dens and fox numbers are greater in oil fields than in undeveloped areas (Eberhardt et al. 1982 and 1983, Burgess et al. 1993, and Burgess 2000). Grizzly bears in and near the oil fields also show better nutrition, greater adult weights, lower cub mortality, and are present in higher concentrations than elsewhere on the North Slope, presumably due to the accessibility of human refuse (Shideler and Hechtel 2000).

The potential for scavengers to be attracted to the proposed export pipeline ROW is greatest during construction, when human activity would be most intensive and wide-ranging along the corridor. Low levels of human activity along the proposed ROW during pipeline operations would have less potential to attract scavengers. Tight controls on the availability of organic refuse will also reduce the potential impacts on foxes and bears.

4.2.5.3 Direct and Indirect Mortality

Increased predator populations around oil field developments may increase predation on prey populations (Martin 1997). This impact is inferred from the higher numbers and productivity of foxes (Eberhardt et al. 1982 and Burgess et al. 1993, Burgess 2000), grizzly bears (Shideler and Hechtel 1995b and Shideler and Hechtel 2000), and gulls and ravens (Truett et al. 1997 and Day 1998) in the North Slope oil fields. There is little information on lemming and vole populations in oil fields adjacent to where Arctic foxes have increased in abundance. Arctic fox could also cause impacts on birds, their primary prey during periods of lemming scarcity . Terrestrial mammalian prey of grizzly bears includes ground squirrels and ungulates (caribou, moose, and muskoxen), particularly ungulate calves. Although grizzly bears are known to prey on caribou in the region (Shideler and Hechtel 2000), the net effect is difficult to quantify. Impacts to colonial bird populations from increased grizzly predation are also a concern. It is anticipated that refuse control efforts, employee environmental sensitivity training, and enforced rules against animal feeding would minimize population-level effects on predators and scavengers and avoid the potential for these animals to negatively affect populations of lemmings or ungulates in the Point Thomson region.

Contaminant spills also have the potential to result in mortality of terrestrial mammals. Contaminants can harm mammals through dermal contact, dermal absorption, ingestion, and inhalation. Dermal contact can include impacts on the ability of hair to insulate or to shed water.

The most common oil field spills (small volume spills of fuels and fluids necessary for vehicle/machinery operations) are unlikely to have population-level impacts on terrestrial mammals. Impacts from large spills are considered in the project ODPCP Plan.

4.2.6 Threatened and Endangered Species

As described in Section 3.9, one threatened species of birds (spectacled eiders) may be found seasonally in the vicinity of Point Thomson. Steller's eiders, also a threatened species, are unlikely to make use of the Point Thomson area. Therefore, the effects of the Point Thomson Gas Cycling Project on threatened birds is restricted primarily to the possible effects on the spectacled eider.

Spectacled eiders are subject to the same types of concerns generally afforded other species of birds on the North Slope. These concerns include the potential for decreased populations (or impediment to recovery) due to habitat loss, disturbance of birds, and decreased productivity. Decreased productivity is generally a secondary effect arising from increased predator populations reducing nest success, including such factors as nest abandonment and predation on eggs or chicks. Protection measures are expected to be applied more conservatively in areas supporting spectacled eiders versus other tundra-breeding birds in general, because spectacled eiders are currently listed as threatened under the Endangered Species Act. The USFWS has developed preliminary protection guidelines for new developments within the breeding range of the spectacled eider. These measures include:

- Prohibiting high-noise facilities, such as gathering centers and airports, within 0.6 mile of nest sites.
- Prohibiting facilities within 0.1 mile (0.16 km) of nest sites.
- Maintaining adequate access for birds to move from nest sites to brood-rearing areas.

4.2.6.1 Habitat Loss and Alteration

The area of habitat altered by the construction of the potential valve pads will account for a very small percentage of available habitat in the Point Thomson region. The amount of habitat lost due to these pads is not expected to have an impact on Spectacled Eiders. Spectacled eiders have been shown to readily use impoundments (Warnock and Troy 1992) and are not expected to suffer adverse impacts should small areas of surface hydrology be changed due to ponding. Similarly, impacts on spectacled eider habitat from snowdrifts, and other temporary changes to habitats resulting from Point Thomson export pipeline construction or operation are expected to be minimal.

4.2.6.2 Direct and Indirect Mortality

Some potential for increased mortality of spectacled eiders may result during poor weather conditions from collisions of low-flying spectacled eiders with elevated structures such as the export pipeline. The potential for such impacts is extremely limited because the Point Thomson area is at the eastern end of the species range on the Arctic Coastal Plain and movements of large numbers of spectacled eiders past Point Thomson are unlikely.

Increased predation levels from attraction of predators to the Point Thomson area may affect small numbers of breeding spectacled eiders. The number of breeding pairs observed in June is low (5 pairs) and only one brood of spectacled eiders has been reported in the area, near Point Sweeney located about 2 mi (3.2 km) east of the West Pad (see Section 3.9). Therefore, increased predation is unlikely to have a population-level effect on spectacled eiders.

As with other birds, the impacts of contaminants on spectacled eiders are dependent on the type of contaminant, season (i.e., when the spill occurs), and the number of birds that could be affected. Because the distribution of most spectacled eiders is located to the west of the main production area at Point Thomson, effects on spectacled eiders related to possible spills are most likely from the pipeline rather than from contaminants found on the drilling and production pads. Impacts from large spills are considered in the project ODPCP Plan.

In conclusion, the direct and indirect effects of the Point Thomson export pipeline will be extremely limited for spectacled eiders because of their relatively low numbers and limited distribution, and the minor amounts of habitat that could be impacted by the pipeline in the Point Thomson project area.

4.3 CULTURAL AND SOCIOEXONOMIC RESOURCES

Impacts of the export pipeline aspect of the project on the socioeconomic characteristics and cultural resources of the area can occur through a reduction or enhancement of population, economy and income, land use and management, and subsistence, recreational and visual resources. The consequences of disruption or displacement, restriction, and destruction are applicable to land use and management, and subsistence, recreation, visual, and cultural resources.

4.3.1 Population

The Point Thomson Gas Cycling project is unlikely to significantly alter the population base of the local communities of the North Slope Borough (NSB) or the state of Alaska. The project is relatively small, requiring 75 personnel for operations, and during the temporary construction phase, 450 personnel. Workers will be housed on site at Point Thomson facilities for both construction and operations phases, avoiding the potential for significant impact to the relatively small village communities in the area. Additionally, this physical disassociation of workers from established local communities would also render it unlikely that incoming construction workers will settle in the NSB. Since construction and operation of the pipeline is a subset of construction and operation of the entire project, impacts are also not expected on population.

The addition of non-resident Point Thomson personnel and their families would be a relatively minor factor in the NSB population of 7,345 (preliminary 2000 census count), and even more so within the population of the State of Alaska, diminishing the overall population impact.

4.3.2 Employment and Income

Impacts of the Point Thomson Gas Cycling Project as a whole on the economy are discussed in detail in the ER. The project as a whole will have a positive benefit on employment, income, revenue, and expenditures. It is not possible to separate out the individual impacts on the economy attributable to pipeline construction and operations. However, they are expected to be incrementally beneficial as well.

4.3.3 Subsistence and Traditional Land Use

The proposed action includes construction and maintenance activities related to the export pipeline that have the potential to affect local residents' patterns of subsistence use. However, in order for there to be a potential impact on subsistence activities, two conditions must be met: 1) the resource has to be present or expected in the area during the period of impact, and 2) subsistence use of the resource has to occur in the impact area.

Impacts on subsistence can be produced by direct or indirect actions on biological resources that result in a displacement or reduction in the animals important for subsistence. Other impacts that could potentially occur are:

- Changes in human behavior, which can include restricting access to a subsistence resource.
- Disruption of subsistence activities, resulting in a reduced harvest.
- Limited subsistence resource use due to the perception that the subsistence experience has been affected or that the resource has been tainted.

4.3.3.1 Winter Construction

Winter construction activities at the Point Thomson project area will include the construction of an ice road to access the Point Thomson site from Prudhoe Bay. Polar bears and ringed seals are the only marine mammals expected to be within the proposed project area during winter construction. Winter construction activities occur during a season in which subsistence use of the project area is low to non-existent. Nuiqsut and Kaktovik hunters do not venture as far afield as the Point Thomson area to pursue their traditional subsistence activities.

Polar bear denning habitat could be encroached upon by onshore pipeline construction and associated ice roads, although a one-mile (1.6 km) avoidance stipulation protects the dens to a large extent. Any subsistence hunting of polar bear in and near the project area would be primarily opportunistic and associated with fall whaling activities. Given the infrequency of polar bear harvest during the winter, potential effects on subsistence use will likely be negligible.

Some localized disturbance of seals is possible due to noise associated with winter construction activities, but overall population effects are not anticipated. Similarly, some localized displacement of seal hunting activities may also occur, but would be minimal in terms of the overall pattern of Nuiqsut seal hunting. Seal hunters from Nuiqsut have reported using the area offshore of Point Thomson in the past, but current harvest rates from the area are low in comparison to other areas. Subsistence hunters in the area tend to rely on caribou hunted closer to the village for their winter protein. As indicated in previous reports (USACE 1999), the area around the Point Thomson project is not currently used as a winter harvest area for caribou for the local villages.

Effects of winter export pipeline construction efforts on terrestrial subsistence resources and their use for subsistence would also be minimal. Use of the project area by subsistence hunters in general is low and is practically non-existent in winter, when trapping and hunting of fur bearers occurs closer to the communities. As a result, export pipeline construction efforts in the winter would not be expected to reduce, restrict, or disrupt subsistence activities.

4.3.3.2 Operations

Noise generated during export pipeline operations is anticipated to be less than that produced during the construction phases. Disturbance effects on local wildlife are anticipated to be minimal and should not affect subsistence resource population levels. To mitigate the potential for adverse effects on wildlife in the area due to attraction of wildlife, personnel will be trained in measures to avoid attracting wildlife, and how to deal with human/wildlife interaction.

Another potential long-term effect of the project is competition for local subsistence resources due to sport hunting and fishing by project personnel. To mitigate this potential effect, hunting by personnel in the vicinity of the project will be prohibited. All personnel will be required to comply with applicable ADF&G sport fishing regulations.

The presence of the pipeline may impede the accessibility of resources for subsistence users. However, subsistence use in the area is low, and the pipeline will be elevated and clearly marked so as to allow passage of humans and animals below.

A significant concern is the potential impact of a pipeline spill or well blowout and subsequent clean up efforts on biological resources and related effects on subsistence activities in the Point Thomson area. The risks and impacts on biological resources associated with a large spill are considered in detail in the project ODPCP plan.

4.3.4 Land Ownership, Use, and Management

4.3.4.1 Ownership

Most of the land in the Point Thomson Gas Cycling Project area is patented to the State of Alaska. All project development will occur on these State Lands under the terms of existing State oil and gas leases. Most leases within the Point Thomson Unit are currently held through Plans of Development that have been submitted and approved by the state on an annual basis.

Federal lands within the Arctic national Wildlife Refuge (ANWR) are located adjacent to the east of the development unit. A Native allotment application has been made on Flaxman Island and a location near Brownlow Point. However, the proposed export pipeline will not be constructed in either of these areas and will not affect land ownership.

4.3.4.2 Land Use

Historic and current land and water use of the Point Thomson area is primarily threefold. It includes oil and gas exploration, occasional traditional and subsistence use by Alaskan Natives, and occasional summer recreation uses along the Canning River within the ANWR border.

The proposed project is consistent with existing oil and gas exploration and production activities in and adjacent to the project area. In terms of the subsistence use of the area, impacts will be minimal (see Section 3.10), primarily because the area is minimally used by the Kaktovik and Nuiqsut villages for subsistence. The greatest potential for disruption of subsistence habits would be to the annual fall whale hunt, and would consist of disruption to the whale migration pattern through noise or transportation interactions. The likelihood that these impacts would be significant is low (see Section 3.10) and will be mitigated to some extent through project controls (see Section 5.0). There will be negligible competition for subsistence resources through additional access to the area for sports fishing and hunting. Project personnel will not be permitted to hunt in the area.

Recreational use in the area mainly occurs in the adjacent ANWR. Development of the Point Thomson pipeline would affect use of surrounding areas for recreation activities to the extent that the presence of the pipeline could marginally interfere with that experience. The pipeline may distract from the visual aesthetics of the region in the eyes of residents and visitors.

4.3.4.3 Land Management

The Point Thomson Unit area has been unitized and is subject to specific agreements and state regulations governing activities within unitized areas. The unit is located within the boundaries of the NSB coastal zone. All development within the unit will adhere to the NSB Title 19 LMRs and the Alaska Coastal Management Program (ACMP). The Point Thomson unit is zoned as a Resource Development District, but any existing Master Development Plans for the area will require revisions.

The construction of the pipeline to connect the Point Thomson Unit with the Badami Unit requires rezoning of part of the pipeline corridor from a Conservation District to a Resource Development District, as designated by the NSB LMRs. This requires the development of a Master Plan for the area, which must demonstrate that the project will not permanently or seriously impair the surrounding ecosystem, nor significantly affect subsistence resources and activities.

The project will be consistent with the existing policies and requirements specified in the various governing ordinances. Mitigation measures proposed in Section 5.0 will assist with compliance. Development plans should receive approval, with likely conditions and stipulations for complying with responsible practices as directed under NSB and ACMP management.

4.3.5 Transportation

Impacts to transportation systems will occur since the project requires the movement of personnel, equipment, materials, and supplies by marine, highway, air, and overland routes for construction and operation. Although the project is not large in size, there will be an increase in movement, particularly during parts of the construction phase.

A one-time construction impact in the form of increased vessel traffic will affect annual sealifts, since project materials will be transported either to Prudhoe Bay and on to Point Thomson by barge, or directly to Point Thomson without a stop in Prudhoe Bay. However, this should create only minor effects on transportation systems and can be mitigated by planning.

Traffic on the Dalton Highway and within the Prudhoe Bay road system is not expected to see a large increase due to the Point Thomson pipeline construction. A dock is proposed at the project site, so that major materials can be sealifted directly into the area instead of being transported via ice or gravel roads from Deadhorse. Piping will be trucked to Prudhoe Bay, and then transported by ice road or barge to Point Thomson. A seasonal ice road will connect the project during the construction phase and potentially during operations; however the expected traffic from Point Thomson activities is unlikely to be significant.

Air and boat traffic in the immediate vicinity of the project, associated with the transport of supplies and personnel between the project site and Prudhoe Bay, will increase during the construction and operations phases. Impacts associated with disturbance of marine and terrestrial animals have been discussed in previous sections 4.2.2 and 4.2.3.. Due to Prudhoe Bay access restrictions, and lack of existing overland access to the site, an increase in public and charter service into Deadhorse related this project would be unlikely.

4.3.6 Recreation

Recreational opportunities in the area include floating the Canning River and camping in ANWR. As the possibility of oil drilling in ANWR receives more public attention, the perceived impairment to recreational opportunities in the area may become an issue with regard to the Point Thomson project development.

Currently, the US Fish and Wildlife Service estimates that 591 visitors are expected in ANWR during 2001. This figure represents visitors arriving with guided tours, but does not include individuals traveling to ANWR. Recreation activities occur during the summer, so would be affected only by summer construction activities and regular operations. The project would provide no actual impediment to the recreational activities as currently practiced; however it may affect the quality of the recreation experience. During construction in particular, the Point Thomson area will be subject to a large number of transportation vehicles, including airplanes and boats, which may create visual and aural impacts, distracting from the recreational experience. Construction effects would last for one to two seasons, with the majority of impact occurring during dark and cold winter months.

4.3.7 Visual Aesthetics

The long-term visual and aesthetic characteristics of the project during operation have the potential to affect both the local residents and visiting recreational users. The natural visual and aesthetic characteristics of the area consist of a low relief, treeless landscape, which means that the oil field facilities, including the pipeline, could be visible from areas physically removed from the site. However, since the pipeline is unlikely to be visible from the Kaktovik or Nuiqsut, and subsistence activities are minimal in the area, impacts to local residents and visitors in the form of decreased localized aesthetic appeal are not expected to be significant (see Section 5.0)

4.3.8 Cultural Resources

The results of the cultural resources reconnaissance survey of the proposed Point Thomson development identified seventeen sites that are listed on the Alaska Heritage Resource Survey (AHRS) archaeological database. Five of these sites are also listed on the NSB's Traditional Land Use Information (TLUI) database. The known sites in the project area are all located along the Beaufort Sea coastline.

Lobdell and Lobdell (2000) described the status of cultural resources in relation to proposed development of the Point Thomson Unit:

Given the extensive research that has taken place from early in this century through concentrated impact-related research beginning in the 1980s and intensifying in the 1990s, it is herein recommended that the Point Thomson Unit receive an area or unit clearance. There is no need for conducting additional cultural resources examinations. Unit operations should buffer and remove areas of all known cultural resources from any potential development or exploration activities. Additional protective measures and unit operating personnel education about the importance of the preservation of these historic sites should be included in HSE certification and personnel training. The sites may require periodic visitation to insure their integrity and the effectiveness of protective measures.

As Lobdell and Lobdell noted, the nature of the project area's landscape, specifically, the dynamic nature of Point Thomson area shorelines, and the expansive areas of low-lying wet tundra, reduces the archaeological sensitivity of the project area. Impacts to any identified or unidentified cultural resources of the area would be either through destruction and/or disruption of the site during construction activities, or through disruption of the artifacts by unauthorized visitors. Destruction could be defined as the physical obliteration of the site, while disruption could involve removal of the artifacts or other impacts to the integrity of site features or artifact locations. With effective protective measures in place, disruption and/or destruction of known cultural resources due to either winter or summer construction efforts are unlikely.

No surface sites or indications of buried cultural sites are identified within the proposed pipeline ROW. If there are any unknown archaeological sites yet to be discovered, they may be inadvertently impacted through pipeline construction. Given the environs elsewhere within the project area, direct impact to cultural resource sites is regarded as highly unlikely. The known archaeological sites are limited in area and well known. There should be no direct adverse effect to the physical remains present at these sites since they can easily be avoided. Mitigation measures of avoidance and sensitivity training of personnel would adequately counter any potential impacts during winter and summer construction activities (see Section 5.0).

Systematic surveys including subsurface testing for deeply buried cultural resource sites in the Point Thomson area are not likely to produce any archaeological resources but may create unintended impacts to fragile permafrost. With the exception of the proposed airstrip and mine site area, further surveys are unlikely to produce cultural resources because of the reduced archaeological sensitivity of the project area. Similarly, the likelihood of submerged cultural resources being located in the area to be impacted by planned dock construction is a low. No shipwrecks are known from the locale (Tornfelt and Burwell, 1992), and no geomorphological features are present to indicate potential ancient buried sites.

However, should cultural resources be discovered during pipeline construction, any work that may damage these resources will be halted, and the State Historic Preservation Officer and the North Slope Inupiaq History, Language, and Culture Commission will be contacted. Following consultation, a decision will be made to avoid, protect, or remove the resource, utilizing appropriate scientific excavation, recording, or testing.

Secondary impacts to cultural resources include destruction or damage to cultural resources and the heritage resource record from unauthorized visitation to, increased pedestrian traffic upon, looting of, or contamination of cultural resources sites. Secondary impacts may occur to sites not directly in the path or footprint of a project, but in close enough proximity to be damaged by the aforementioned activities. The impacts could occur either during construction or operations activities. To mitigate any potential secondary impact, all project personnel will receive training on the importance of cultural resources and will be instructed to avoid these sites. The training will include a discussion of the penalties for disruption of any cultural site. The lack of a permanent access road along the pipeline route thereby restricting year-round access to the Point Thomson area will aid in mitigating secondary impacts.

4.4 CUMULATIVE EFFECTS

Potential direct and indirect effects of the proposed project activities were identified using information from the Point Thomson ER, Environmental Impact Statements (EIS) from other oil and gas projects, North Slope resource studies, and peer reviewed literature. This section briefly describes the cumulative effects of the project's export pipeline-related activities. Cumulative effects are discussed in detail in Section 7.0 of the ER.

One of the spatial or geographic areas that was used in the cumulative effect analysis that encompasses the proposed export pipeline corridor is from the Badami Facility east to the Canning River, north to the barrier islands, and to the southern boundary of the Point Thomson Unit. This spatial area was used for the following resource categories that are applicable to the proposed export pipeline route:

- Physical and Chemical Resources
- Vegetation and Wetlands
- Birds
- Polar Bears
- Moose, Grizzly Bear, Muskoxen, and Arctic Fox
- Threatened & Endangered Species

- Cultural Resources

Based on the analysis of potential impacts associated with the Point Thomson Gas Cycling Facility, in conjunction with impacts from present and potential future external actions, it has been determined that cumulative impacts on all of the resources listed above could occur. However, the likelihood that any of the potential cumulative effects could be significant is low, based on the numerous mitigation measures that will be in place during the project activities (see Section 5.0 following).

5.0 MITIGATION MEASURES

Mitigation measures are specific controls integrated into the project design and operations. The measures are intended to alleviate potential impacts to the physical, biological or human environment that could occur due to the (project) construction and/or operations. This section describes potential mitigation measures that could be considered in the design of the proposed Point Thomson Gas Cycling Development Project. Potential mitigation measures relating to export pipeline activities organized by environmental issues are summarized in Table 5-1. The table also discusses the anticipated effect or benefit of each measure.

Primary export pipeline-related construction mitigation measures include:

- Adequate separation of road and export pipeline between the CPF and West Pad to minimize obstruction impacts on wildlife,
- Avoidance of high value wildlife habitats (salt marshes, lagoon, etc.) in siting of structures
- Reuse of existing gravel pads where practicable.
-

To minimize environmental impact, all construction involving on-tundra activities will take place during winter. These activities include pipeline construction from ice roads and ice pads, and construction of the potential gravel valve pads.

By conducting major construction activities in winter, disturbance to wildlife will be minimized, and impacts to tundra, other than those specifically authorized by permit, will also be minimized. Minor displacement of some breeding birds would be anticipated as a result of construction of the potential gravel valve pads. Noise and other disturbances associated with production operations will occur at the production sites; however, these changes are not expected to influence either breeding success or population dynamics of the species involved (see Troy and Carpenter 1990). Similarly, caribou may be displaced from some areas of the project site; however, experience from the North Slope oil fields indicates that caribou will use gravel pads and other facilities as insect relief habitat because insect abundance is often lower on gravel pads compared to undisturbed tundra (LGL 1993b and Pollard and Noel 1994).

Measures used for protecting air and water quality, and for managing wastes during construction, will be continued as appropriate through project operation. These measures are also summarized in Table 5-1.

of

Table 5-1 Potential Mitigation Measures: Export Pipeline Construction and Operation

ISSUE/RESOURCE	POTENTIAL MITIGATION MEASURE	EFFECT
General	1) Maintain continual on-site environmental presence during construction and operation following ExxonMobil Operation Integrity Management System (OIMS) guidelines 2) Strictly enforce speed limits within project areas; train personnel in interactions with wildlife 3) Establish an environmental/cultural awareness and training program 4) Conduct permit compliance training 5) Conduct periodic health, safety and environmental compliance audits	1) Assure compliance with permit requirements and all applicable federal, state, and local laws 2) Reduce potential for impacts on wildlife, reduce accidents and spill potential on tundra, sea ice, and marine environment 3) Both 1) and 2) above 4) Same as 1) 5) Independent performance assessment
Air Quality	1) a) Plan construction activities to stagger tasks and minimize concurrent sources b) Implement operational scenarios that minimize concurrent source operation c) Water gravel surfaces to reduce dust generation	1) Reduce the volume and impact of air emissions
Water Quality	1) a) Conduct construction during winter b) Locate pads to minimize blockage of natural surface water drainage c) Use culverts and berm breaks to restore natural surface water drainage d) Limit water removal under ice in fish bearing water sources so as not to exacerbate low dissolved oxygen levels in winter	1) Minimize impacts due to construction/presence of facilities
Tundra/Wetlands	1) a) Minimize valve pad footprints to meet operational needs b) Use ice roads for construction and seasonal access 2) a) Conduct major construction efforts in winter for pads and pipeline b) Use ice roads for seasonal access c) Based on hydrological studies, optimize siting of valve pads to minimize alternations in surface water drainage patterns. d) Design pipeline and valve pads to minimize impacts to drainage and permafrost e) Institute and enforce environmental sensitivity training for construction and operations personnel f) Design emergency response and containment procedures in case of a spill g) Rehabilitate and re-seed any impacted areas and monitor restoration.	1) Reduce acres of tundra physically covered by gravel 2) Reduce tundra disturbance

Table 5-1 Potential Mitigation Measures: Export Pipeline Construction and Operation

ISSUE/RESOURCE	POTENTIAL MITIGATION MEASURE	EFFECT
Fish and Fish Habitat (including anadromous, marine, and freshwater)	1) a) Do not use streams for water source in winter b) Limit work in streams in known spawning areas and prevent work during fish spawning runs, if any. c) Winter construction for potential valve pads and pipeline d) Limit winter water withdrawal in fish bearing water sources, if any in area, to 15% of available water under ice. 2) a) Based on hydrological studies, optimize siting of valve pads and pipeline stream crossings to reduce alterations to surface water drainage patterns b) Minimize stream crossings and construction activities in streams. c) Limit winter water withdrawal in any fish bearing water sources to 15% of available water under ice. d) Do not use streams for water source in winter e) Conduct major construction efforts in winter for pads and pipeline f) Institute and enforce environmental sensitivity training for construction and operations personnel g) Only cross streams (tundra travel) where solidly frozen.	1) Minimize direct impact/mortality of fish 2) Maintain optimal fish habitat

Table 5-1 Potential Mitigation Measures: Export Pipeline Construction and Operation

ISSUE/RESOURCE	POTENTIAL MITIGATION MEASURE	EFFECT
Wildlife and Habitat	1) Caribou and Muskoxen a) Use 5 ft (1.5m) high pipelines b) Design infield road and pipeline with a 300 ft (152.4m) separation c) Conduct major construction efforts in winter for pads and pipeline d) Institute and enforce environmental sensitivity training for construction and operations personnel e) Institute a no hunting policy for site workers f) Prepare wildlife interaction plan 2) Birds a) Review historical data and conduct baseline studies of use within the project area to optimize project siting and design b) Properly manage wastes and garbage c) Prohibit feeding by personnel d) Limit water removal from freshwater lakes e) Prepare wildlife interaction plan 3) Other mammals including grizzly bear and fox a) Properly manage wastes b) Prohibit feeding by personnel c) Institute and enforce environmental sensitivity training for construction and operations personnel d) Strictly enforce speed limits within project area e) Use bear-proof dumpsters	1) Minimize disturbance to migrating caribou and musk oxen 2) Minimize impacts to tundra nesting, waterfowl and predatory birds 3) Minimize impacts to these mammals

**Table 5-1 Potential Mitigation Measures:
Export Pipeline Construction and Operation**

ISSUE/RESOURCE	POTENTIAL MITIGATION MEASURE	EFFECT
Marine Mammals	1) Pinnipeds a) Minimize construction noise during all seasons by using and maintaining high quality mufflers and sound proofing where available b) c) Institute and enforce environmental resource sensitivity training for construction and operations personnel d) Avoid haul-out areas should any be identified in the transportation corridor e) Build sea-ice road on grounded ice (not seal habitat) f) Begin sea-ice road construction as early as possible 2) Polar Bears a) Develop and implement polar bear interaction plan b) Partner with USFWS in yearly polar bear surveys and studies c) Conduct major construction efforts in winter for pads and pipeline d) Utilize facility design that minimizes polar bear and human interactions e) Locate and avoid historic polar bear denning areas f) Avoid dens by 1 mile g) Use forward-looking infrared (FLIR) technology to locate densities along ice road routes h) Ensure appropriate set back from denning areas i) Report any den encountered j) Manage wastes to avoid attracting polar bears k) Institute and enforce environmental sensitivity training for construction and operations personnel l) Prepare polar bear interaction plan m) Use bear-proof dumpsters	1) Minimize disturbance to pinnipeds, both long and short term residents in Lion Bay 2) Minimize disturbance to denning polar bears in the project area.
Threatened and Endangered Species	1) Spectacled and Steller's Eiders a) Coordinate with USFWS on Spectacled eider surveys b) Conduct major construction efforts in winter for pads and pipeline c) Institute and enforce environmental resource sensitivity training for construction and operations personnel	1) Protect these endangered/threatened species

**Table 5-1 Potential Mitigation Measures:
Export Pipeline Construction and Operation**

	ISSUE/RESOURCE	POTENTIAL MITIGATION MEASURE	EFFECT
5-7	Subsistence	1) a) Identify subsistence use and areas potentially affected by the project b) Conduct major construction efforts in winter for pads and pipeline c) Prohibit hunting by construction and operations. Only allow fishing with required State license and following State regulations d) Institute and enforce subsistence resource sensitivity training for construction and operations personnel e) Obtain and respond to community input f) Develop conflict avoidance agreement for marine mammals, if needed	1) Minimize disturbance to subsistence resources and activities
	Cultural Resources	1) Archeological Sites a) Locate and avoid archeological sites b) Obtain and incorporate local information about important historical sites c) Maintain confidentiality of site locations d) Institute and enforce cultural resource sensitivity training for construction and operations personnel	1) Protect cultural resources in the Point Thomson area
5-8	Cultural Values	1) a) Obtain and respond to community input 2) a) Minimize visual impacts such as lights and structural profile b) Facility design to include no permanent road connecting project to state road system and other facilities and therefore no direct connection to other communities c) Institute and enforce cultural resource sensitivity training for construction and operations personnel d) Use local resources for construction and development labor	1) Ensure community input to project design and operations 2) Minimize impacts to local culture or ensure that impacts will be positive

Table 5-1 Potential Mitigation Measures: Export Pipeline Construction and Operation

ISSUE/RESOURCE	POTENTIAL MITIGATION MEASURE	EFFECT
Spill Prevention	1) a) Provide leak detection, monitoring and operating procedures for the export pipeline 2) a) Ensure adequate spill response equipment and personnel are available to respond b) Build spill controlling berm strategies into valve pads c) During construction, locate fuel storage and transfer locations away from river crossings and wetlands d) Use secondary containment at all fuel storage locations e) Train personnel in acceptable refueling procedures and allowed locations for refueling f) Use drip pans and liners during refueling and vehicle maintenance procedures	1) Reduce risk of spills/leaks 2) Reduce effect of spills; improve ability to respond/clean up spills
Recreational and Visual Effects	1) a) Reduce indirect lighting as much as possible b) Reduce structural profile where practical. c) Use natural color schemes that blend with environment	1) Minimize emissions and visibility impacts

6.0 Termination

The expected life of the Point Thomson Gas Cycling Project is about 30 years. Abandonment timing will be determined based on the need for the facilities. Detailed abandonment procedures will be developed at the time of project termination. Specific plans will depend on the facilities in place and the specific requirements applicable to those facilities at the time of abandonment.

Abandonment activities will be consistent with lease terms, requirements in the Unit Agreement, permit conditions, and other applicable regulatory requirements. Abandonment plans will be subject to review by multiple agencies, with input from other local, state, and federal agencies, and likely will involve some degree of overlapping authority.

7.0 REFERENCES

The reference list is provided in the *Point Thomson Gas Cycling Project Environmental Report* produced by URS Corporation, and issued on July 31, 2002. Additional description of this project is available in the current version of the *Point Thomson Gas Cycling Project: Project Description*.